

# VISUALIZATION PRINCIPLES IN 3D CADASTRE: A FIRST ASSESSMENT OF VISUAL VARIABLES

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3<sup>rd</sup> International FIG Workshop on 3D Cadastres, China, 2012

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- Context of research
- Problematic
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- Conclusion and future works



# Context

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- Visualisation of 3D Cadastre
    - Technical aspects
      - Visualization software
      - Data preparation and model construction
      - System framework designs
    - Theoretical aspects
      - Innovative methods of depiction
      - Link visualization with specific demands
      - Fundamental for reasonable and efficient visualization
- (Wood, J et al., 2005)*



# Problematic

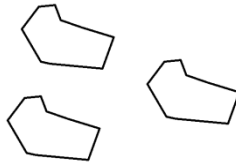
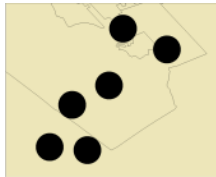
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- Not many researches have been done in theoretical aspects of visualization of 3D Cadastre
- Two interesting questions
  - What are special requirements for 3D cadastre visualization?
  - What principles in visualization of 3D cadastre lead to reasonable and efficient visualization?

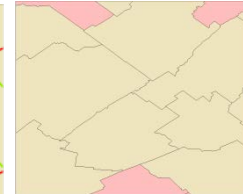
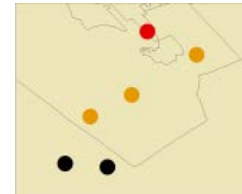


# 7 Visual Variables

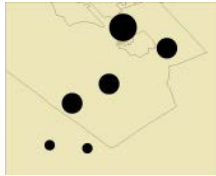
Position



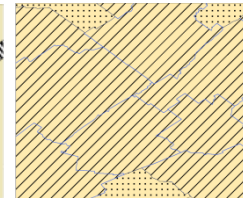
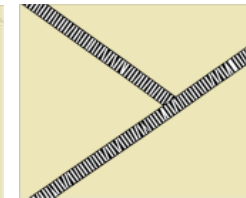
Color



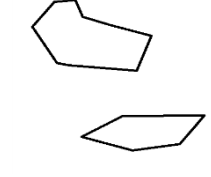
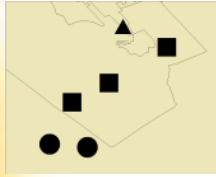
Size



Texture



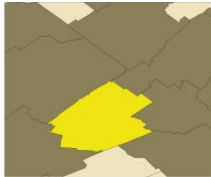
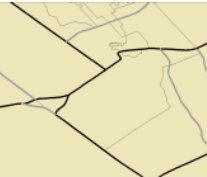
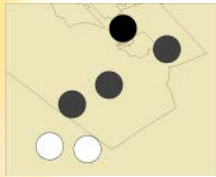
Shape



Orientation



Value



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# Visual Variables

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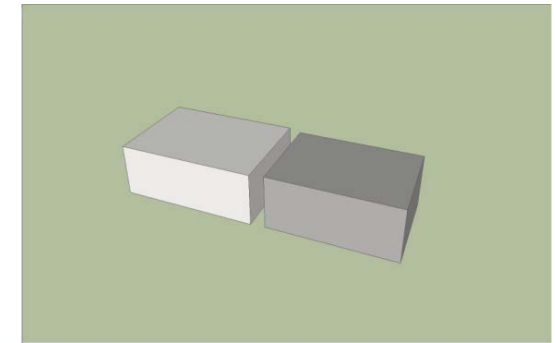
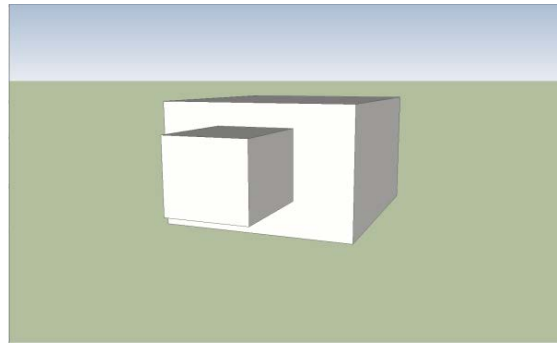
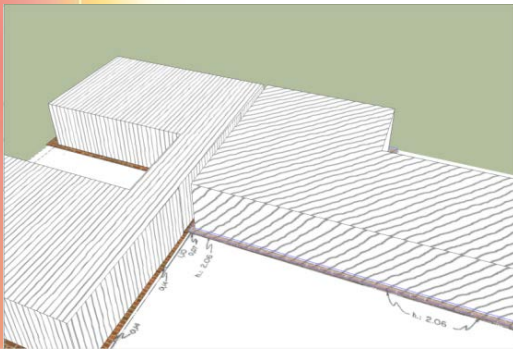
- 5 Characteristics

- • Selective
- Associative
- Quantitative
- Order
- Length



# Visual Variables

- Some limits in 3D visualization (in a 2D display)
  1. Bertin's visual variables were defined and assessed for 2D cartographical mapping
  2. Some ambiguities may occur because of
    - Projection
    - Occlusion
    - Shading



# Objectives

- Investigate which among visual variables are more appropriate for geo-visualization of 3D legal units in 3D cadastre
  - Based on literature review, propose a synthesis of the requirements for 3D cadastre visualization
  - Compare the capability of the 7 visual variables separately to fulfill specific requirements for 3D cadastre visualization





# Requirements for 3D cadastre visualization

- Sources:
  1. Survey on the usages of 2D/3D cadastre for municipal management, Technical report, Québec, Canada (*Boubehrezh, A., & Pouliot, J, 2012.*)
  2. Literature review (30 articles):
    - The first and the second international workshops on 3D cadastre
    - FIG Working Week 2012



# Requirements for 3D cadastre visualization

1. Represent bounded and partial bounded 3D legal units
2. Represent the relationships between 3D legal units and 2D cadastre parcels
3. Represent the relationship of 3D legal units with its corresponding physical objects
4. Represent spatial relationships among 3D legal units
5. Label with official measurements



# Methodology

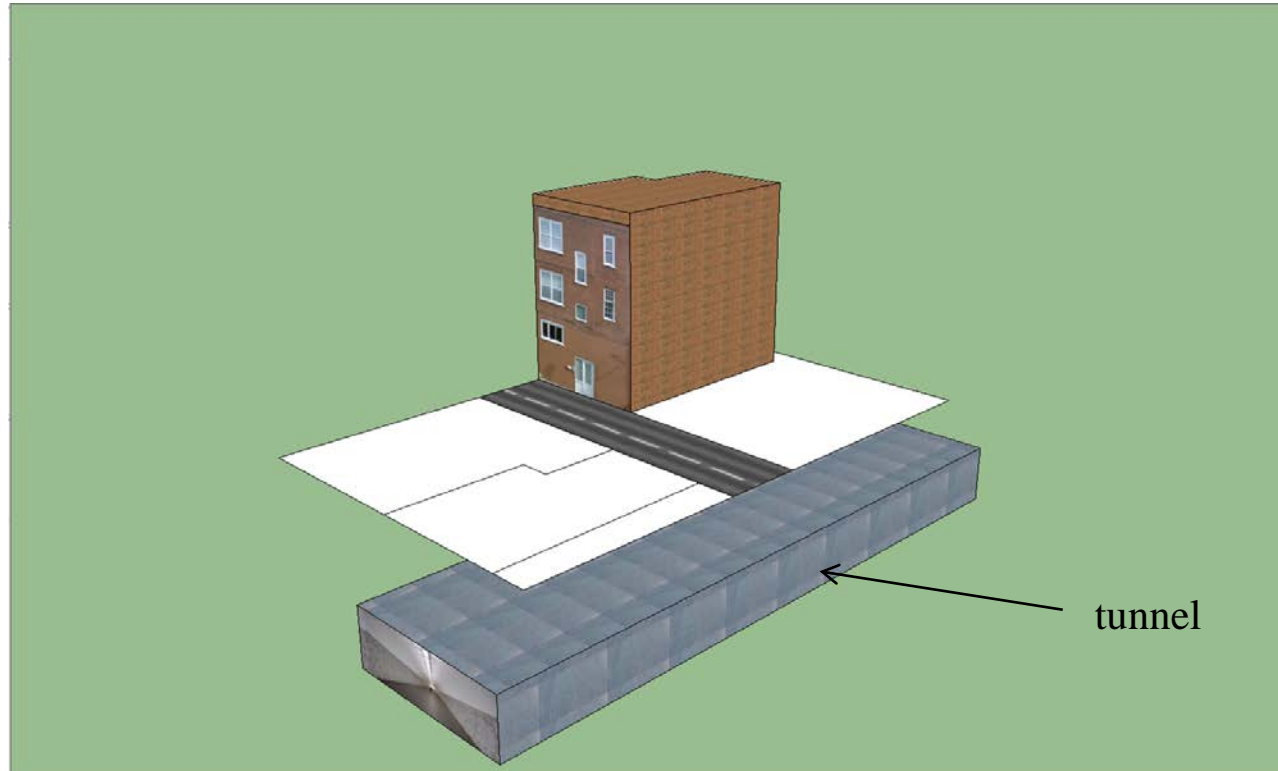
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- Assessment of 7 visual variables considering the 5 requirements of 3D cadastre visualization
  - Select a 3D scene for each of these requirements
  - Apply change of each visual variable alone in these scenes
  - Assess the capability of each visual variable for each one of these scenes
- Because of time limit, only two requirements will be presented



# Represent bounded and partial bounded 3D legal units

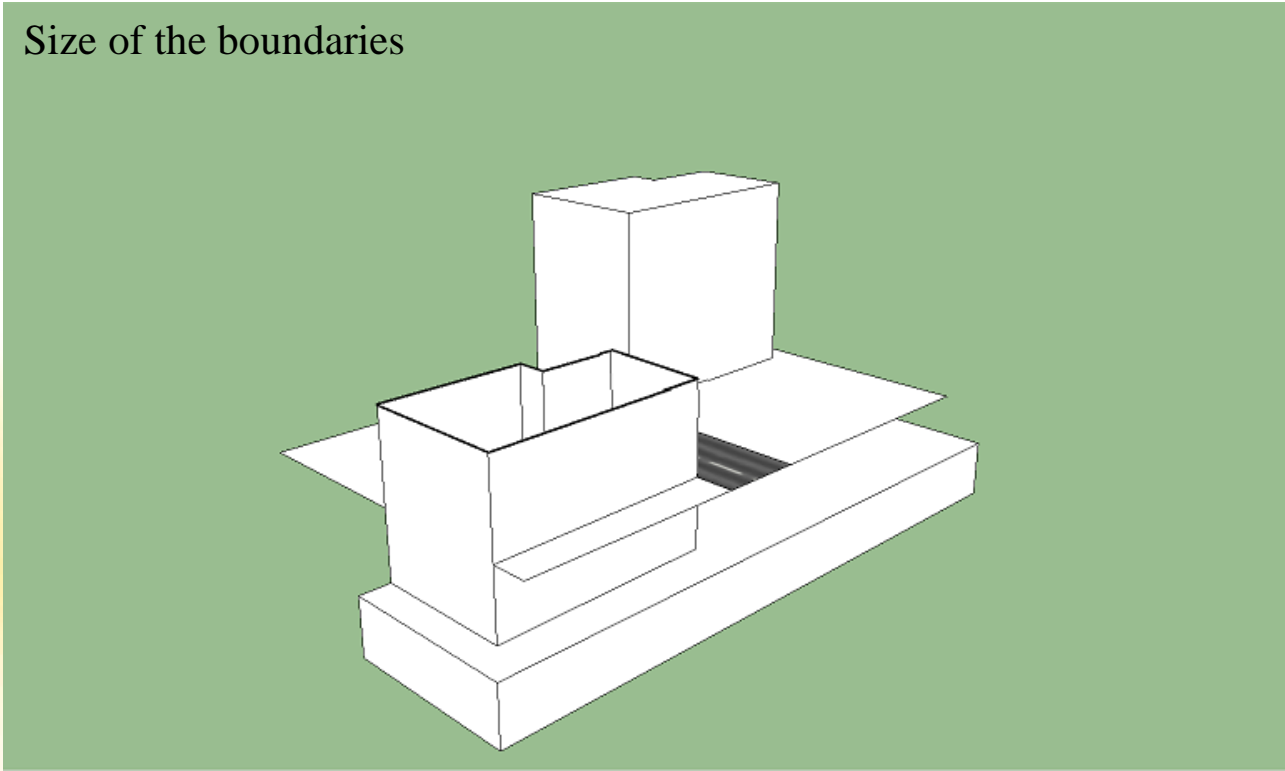
- Bounded and partial bounded 3D legal units



# Represent bounded and partial bounded 3D legal units

- Without closed volume

Size of the boundaries



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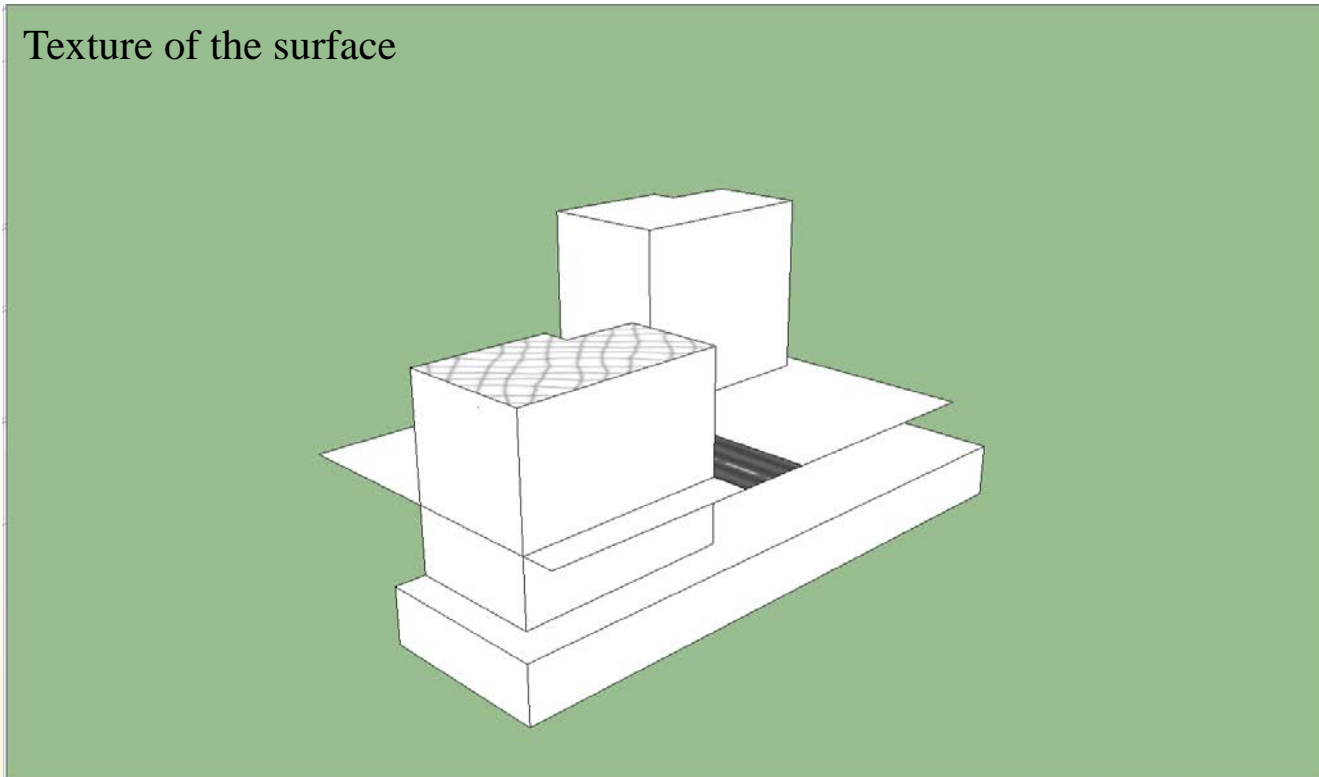
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# Represent bounded and partial bounded 3D legal units

- With closed volume

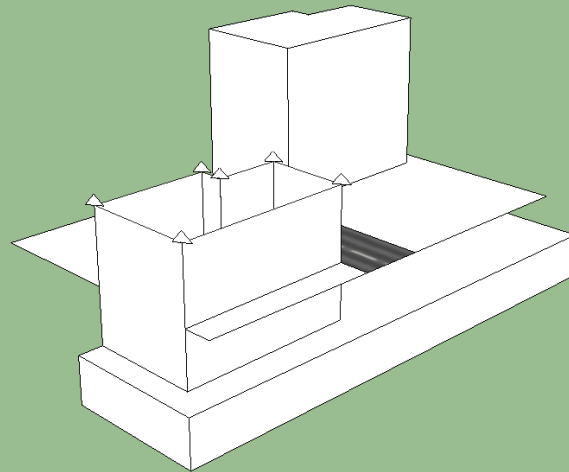
Texture of the surface



# Represent bounded and partial bounded 3D legal units

- Other visual variables

Change shape of vertex



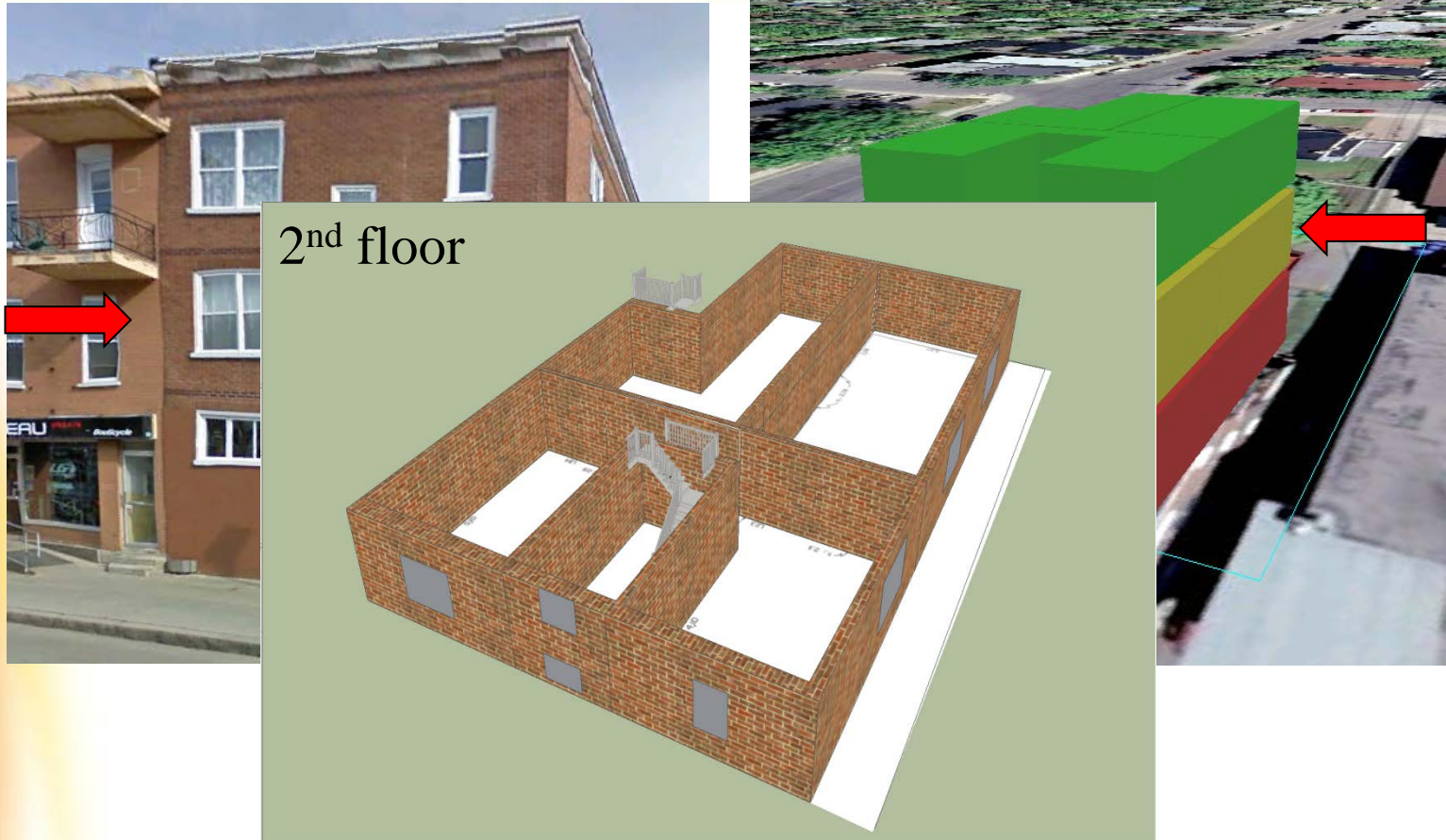
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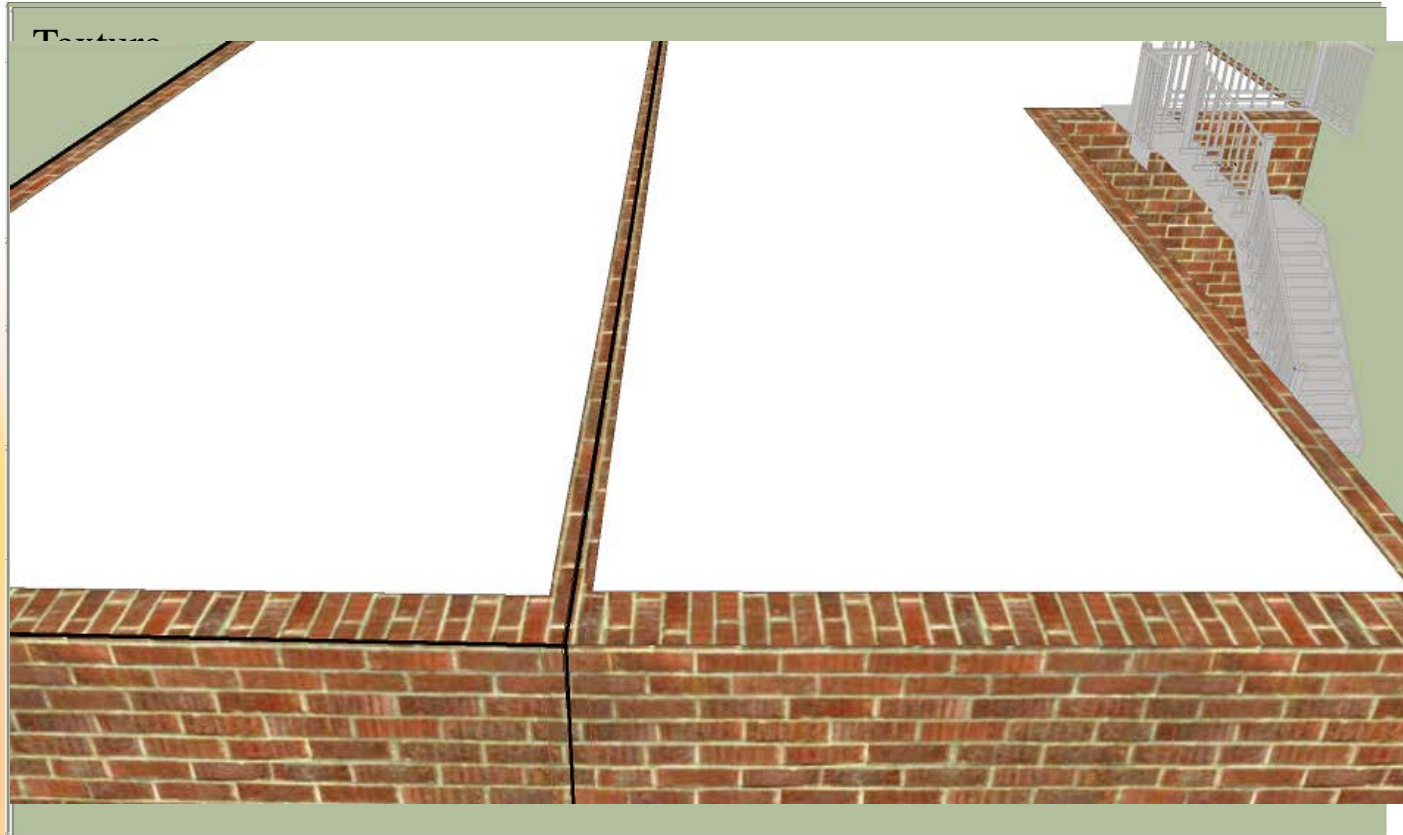
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# Relationships between 3D legal units and corresponding physical objects





# Relationships between 3D legal units and corresponding physical objects



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# Results

Requirements for 3D cadastre visualisation	Position	Orientation	Size	Shape	Value	Color	Texture
1.Bounded and partial bounded 3D legal units	Yes	Maybe	Yes (bound aries, surface )	Yes (boundari es, surface)	Maybe	Yes	Maybe
2.The relationship of 3D legal units with corresponding physical object	No	Maybe	Yes(bou ndaries)	Yes(bound aries)	Maybe	Yes	Maybe



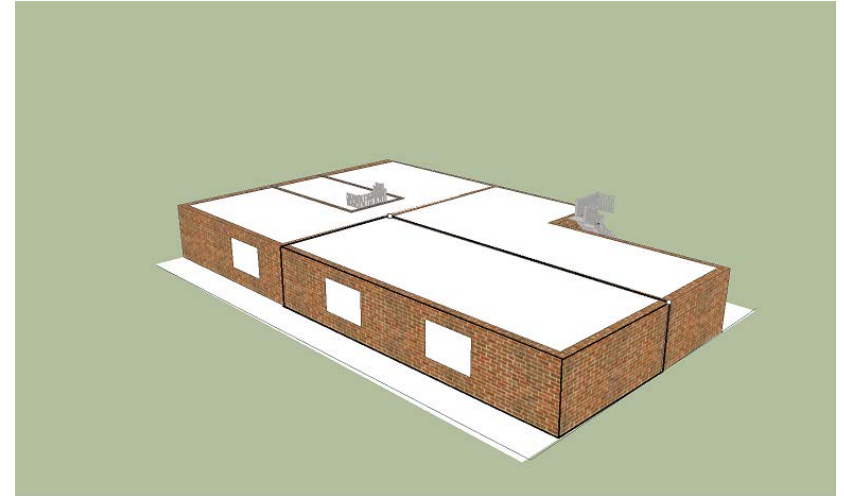
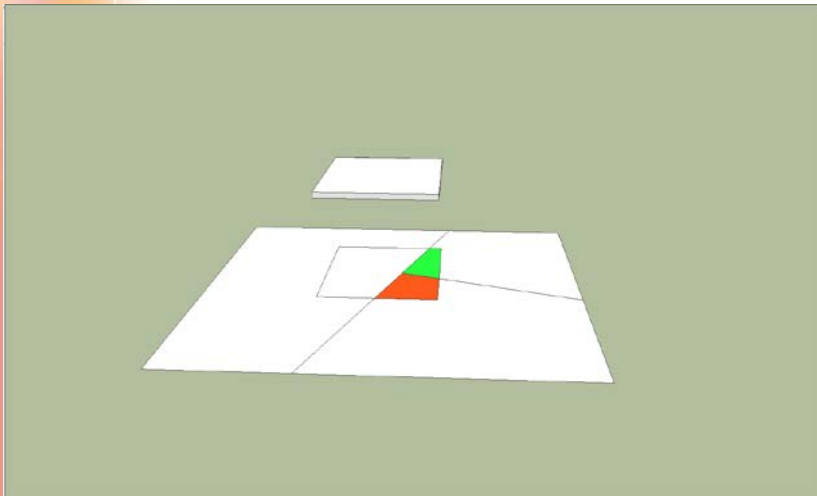
# Results

Visual variables Requirements for 3D cadastre visualisation	Position	Orientation	Size	Shape	Value	Color	Texture
<b>3.The relationship between 3D legal units and 2D cadastre parcels</b>	No	Maybe	Yes(b ounda ries)	Yes(bou ndaries)	Yes	Yes	Maybe
<b>4. Spatial relationships among 3D legal units</b>	No	Maybe	Yes(bo undari es)	Yes(boun daries)	Maybe	Yes	Maybe
<b>5. Label with official measurements</b>	No	No	Yes	No	Yes	Yes	No



# Discussions

- Applicable visual variables:
  - **Color** is suitable for different requirements
  - Change **size** and **shape** of boundaries or outline is a promising method for different task.



# Discussions

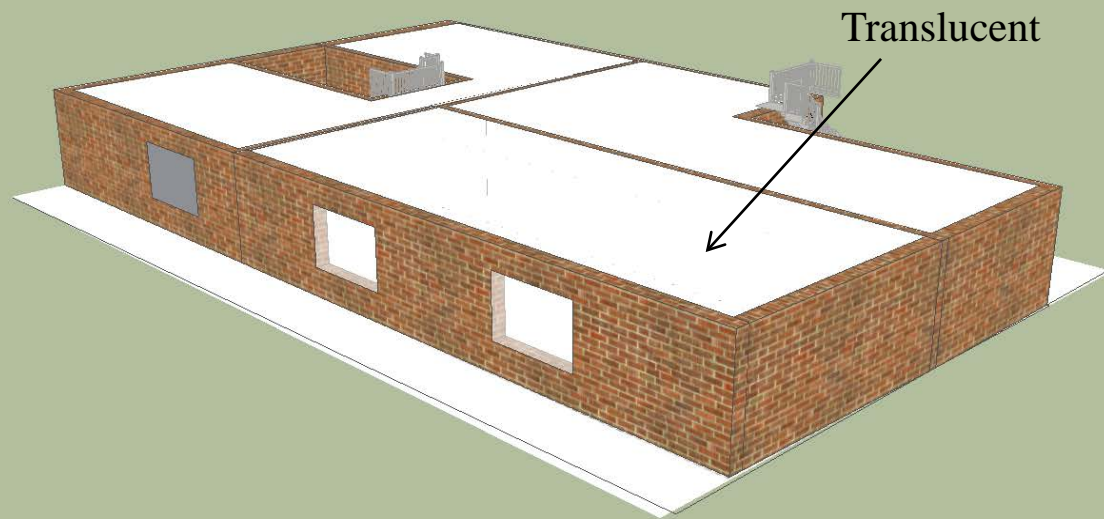
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- Not applicable:
  - Some of the visual variable could not be changed for certain symbols since it modifies the geometry meaning of the object
  - Size of symbols could not be too small in order for audience to perceive. Thus, the changes of value and color of the vertex of 3D legal units could hardly be preserved.



# Discussions

Transparency affected by objects behind



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# Conclusion

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- Visualization of 3D cadastre have special requirements
- The capabilities of visual variables are different from those in 2D cartographic design process (2D cadastre maps)
- The research in theoretical aspects of visualization of 3D cadastre could lead to a more reasonable and efficient visualization



# Future works

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- Evaluate combination of visual variables
- Evaluate different highlighting techniques
- A preliminary design based on all these assessments
- Validation with potential users





Thank you!  
Merci!  
谢谢!



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