



Application of 3D GIS to 3D Cadastre in Urban Environment

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深圳市规划和国土资源委员会

Urban Planning Land and Resources Commission of Shenzhen Municipality

Application of 3D GIS to 3D Cadastre

- **Introduction**
- **3D Cadastre and 3D GeoSpace**
- **3D data and 3D modelling**
- **Visualization**
- **Applications and Practices**



3rd International Workshop on 3D Cadastres, 25-26 October 2012, Shenzhen, China

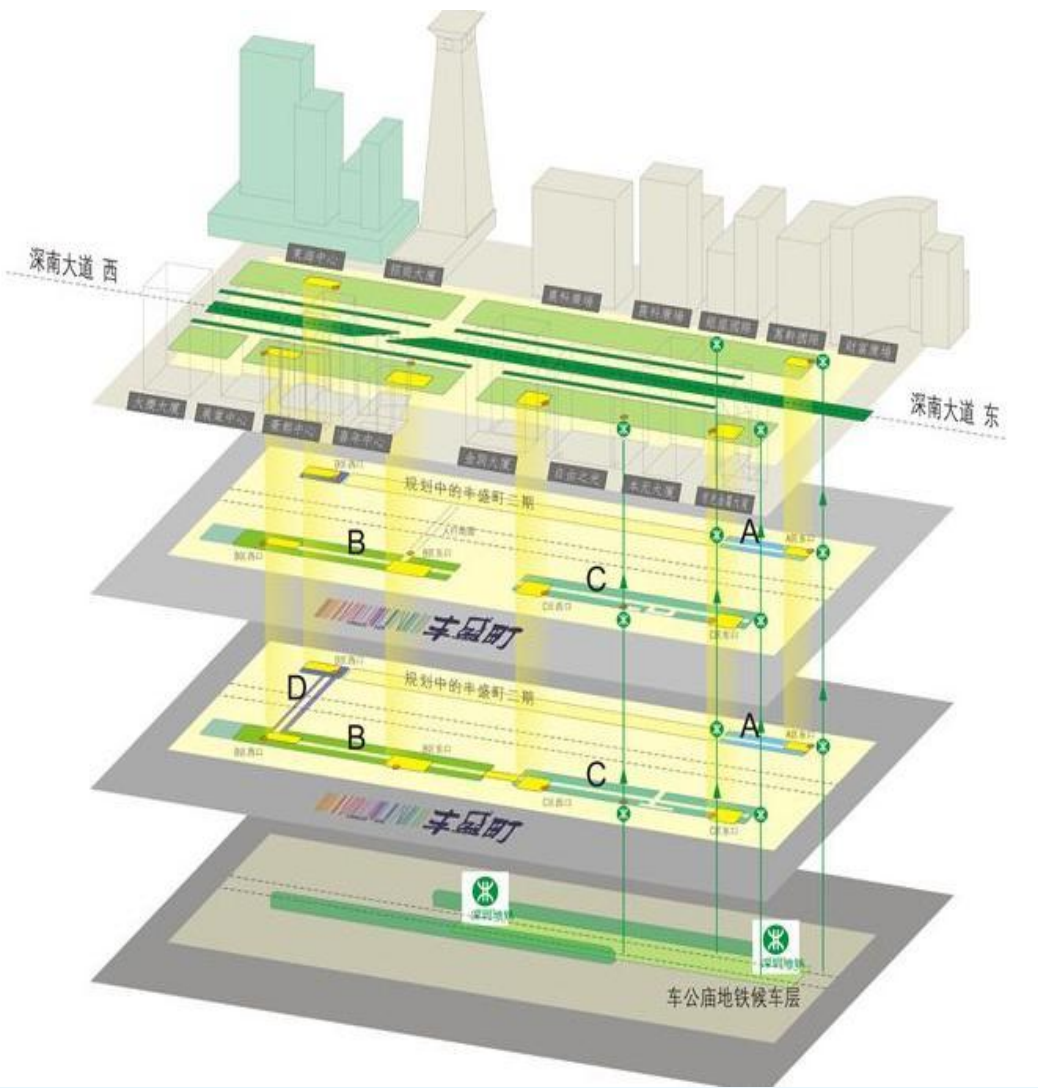
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Land use in multi-layers



1. Introduction

- **Rapid development -> urban 3D developments and utilization.**
- **Cadastral management: (land and other real estates or properties)**
 - division of urban space with no overlay
 - registering legal status, attributes and rights
- **a huge challenge for governments**
- **to break through 2D IS**



1. Introduction

- In China, **Property Law** had been enacted to support the 3D confirmation of the cadastral objects.
- It provides the **legal foundation** to establish the 3D cadastral system.
- **Urgent task**: to define the 3D cadastral object, represent its 3D space and associate it with its attributes and rights.

3D Cadastre

- Represent 3D geometries of cadastral objects
- Handle spatial relationships
- Manage them with spatial-temporal relationships along with parties as well as RRR

3D GIS

- Representation of 3D geometry and O-O Tech.
- 3D topology
- Visualization
- Management
- Information service



Unit?

- **Goodchild: “What use cases exist for 3D/4D data? ... For example, What are the primitive elements of a GIS representation of a building, and what is the relationship between architectural design and GIS representation?”**
- **3D cadastre is a typical case for 3D data, and a 3D property unit is a basic unit in a 3D urban management system. ->4D**
- **3D property unit is a comprehensive concept that integrates lands, houses or other real estates with 3D data, parties and human behaviors.**

3D GIS applying to 3D cadastre...

- **What is 3D space in 3D cadastre and what is its particularity?**
- **Can 3D data collection in 3D GIS also be used in 3D cadastre?**
- **Are there any special requirements in 3D modeling and management in 3D cadastre?**
- **What's the difference of visualization between 3D GIS and 3D cadastre?**
- **What kind of decision-making support can be provided with 3D GIS for 3D cadastre?**
- **Can 3D WebGIS be suitable for dissemination and publish of 3D cadastral information?**

2. 3D Cadastre and 3D Geospace

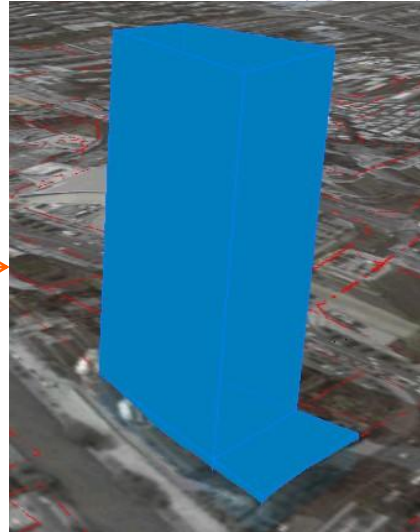
- 3D cadastre is a discrete division of 3D urban geospace.



RRR



Register



These occupations of 3D geospace are the kernel and the essence of 3D cadastral objects.



-> Gene of the 3D cadastre

3. 3D Data and 3D Modelling

geospatial modeling

GIS

3D Cadastre

- Admin Boundary
- Road
- Block
- Terrain
- ...

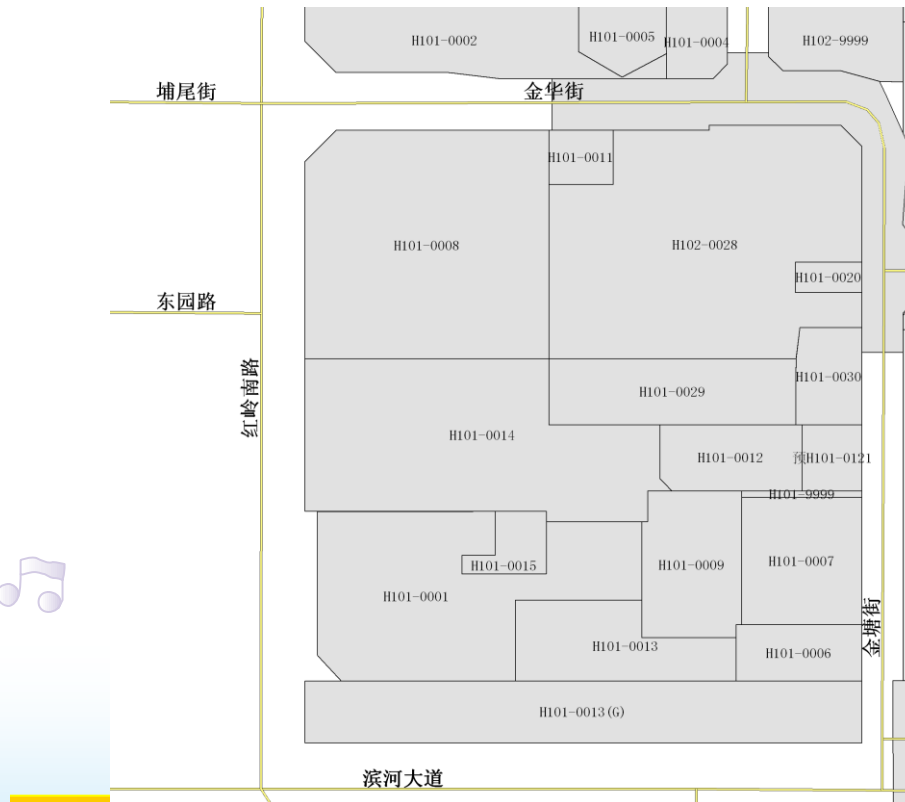
- 3D boundary point
- 3D land parcel
- 3D building
- 3D property unit
- ...

3D Geometric primitive

Cadastral data

- Geometries by Surveyors

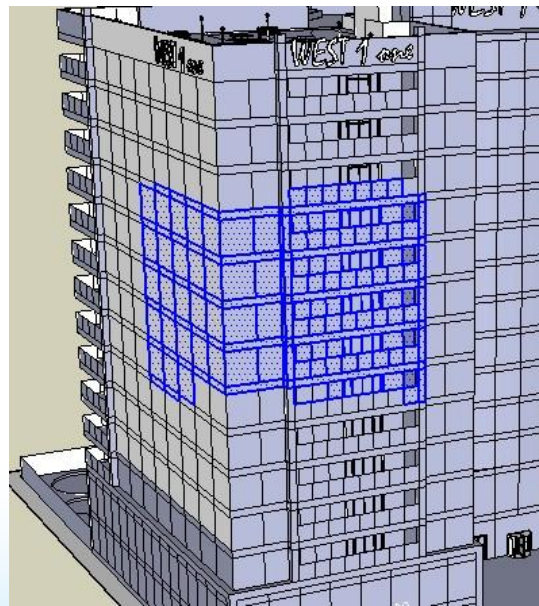
- RRR by Registration



3D Spatial Data

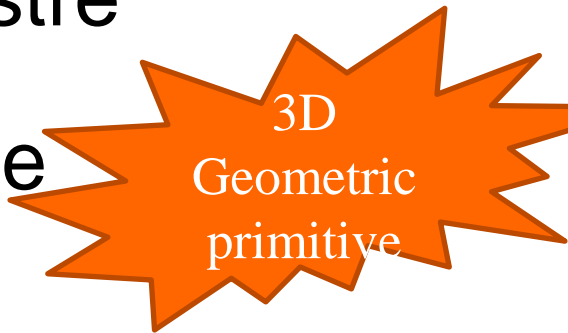
3D GIS

2D, 2.5D, 3D
3D physical shapes



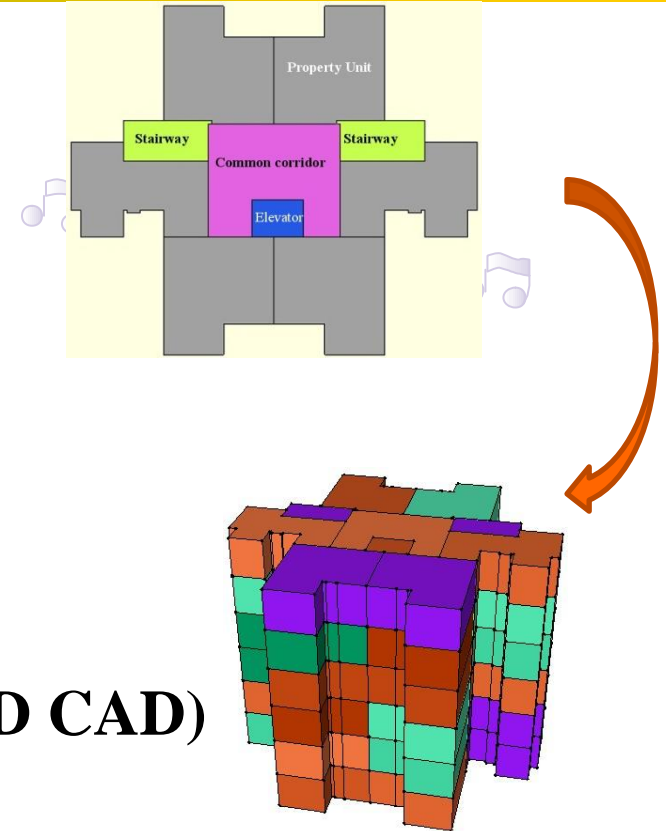
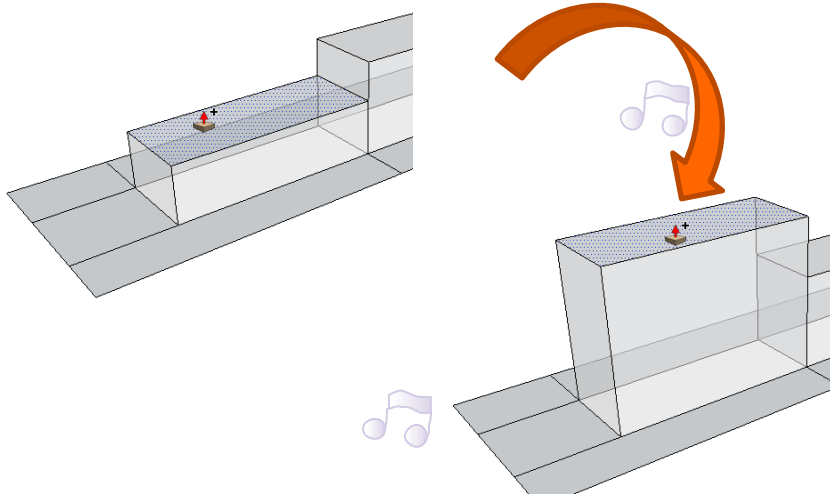
3D Cadastre

3D space



->3D Spatial Data

- Extruding the existing 2D footprint



- Constructing solid from sets of faces (3D CAD)

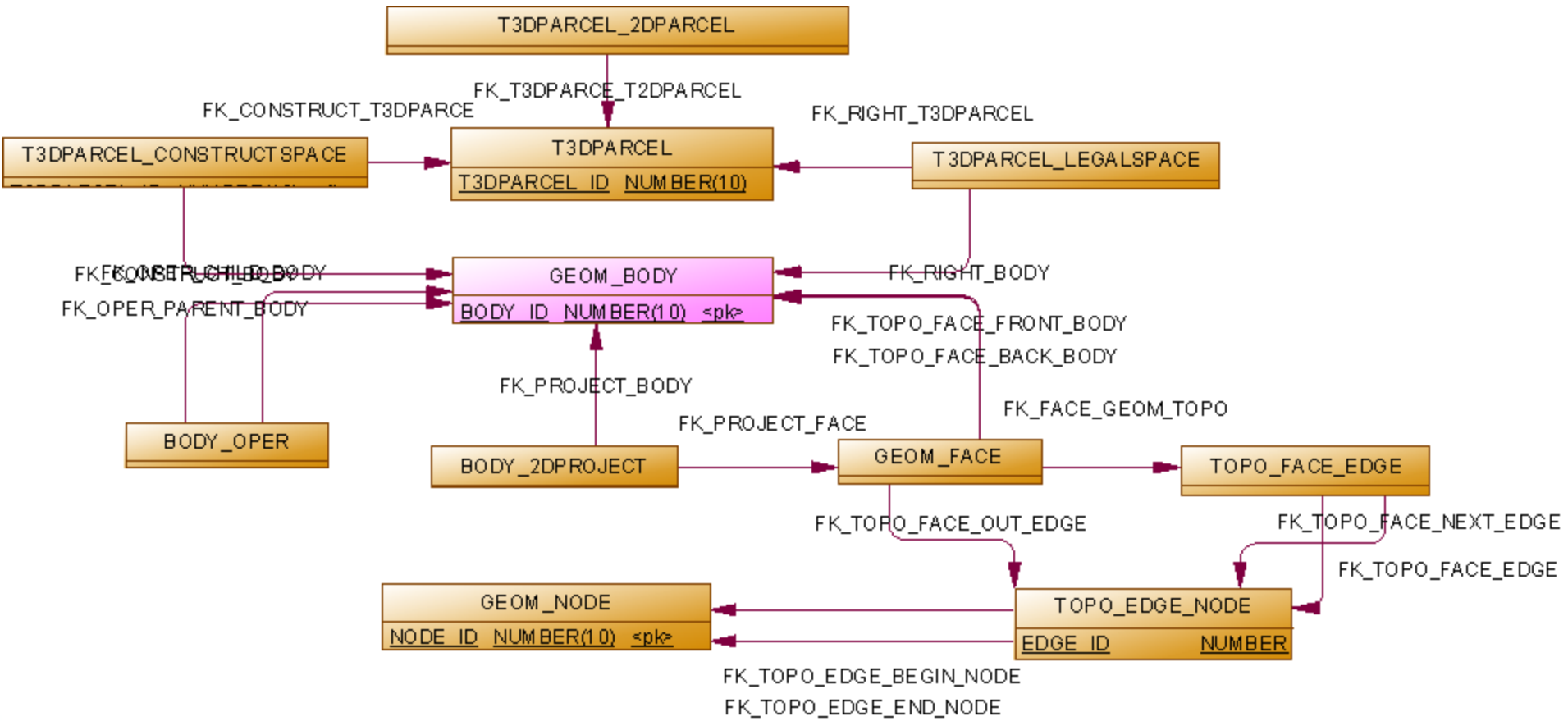
- BIM, CityGML:

- difference of the elements, geometry and semantics
- (roof, room, wall, thickness...)

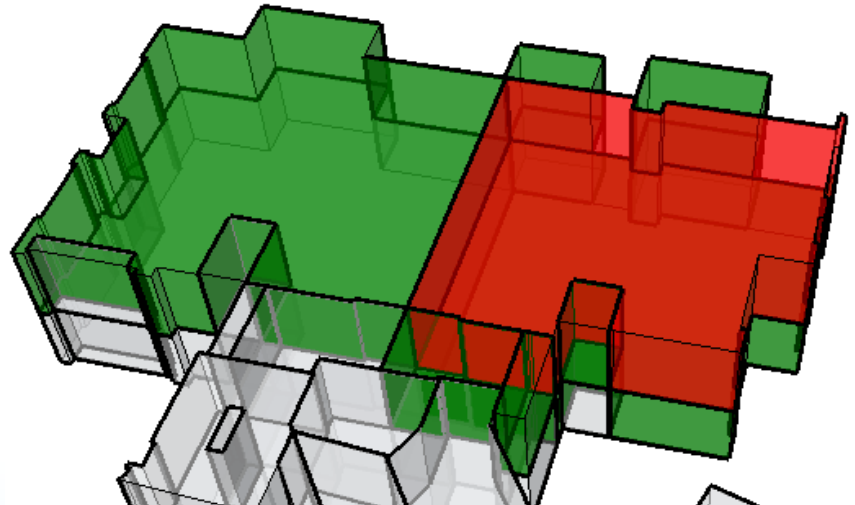
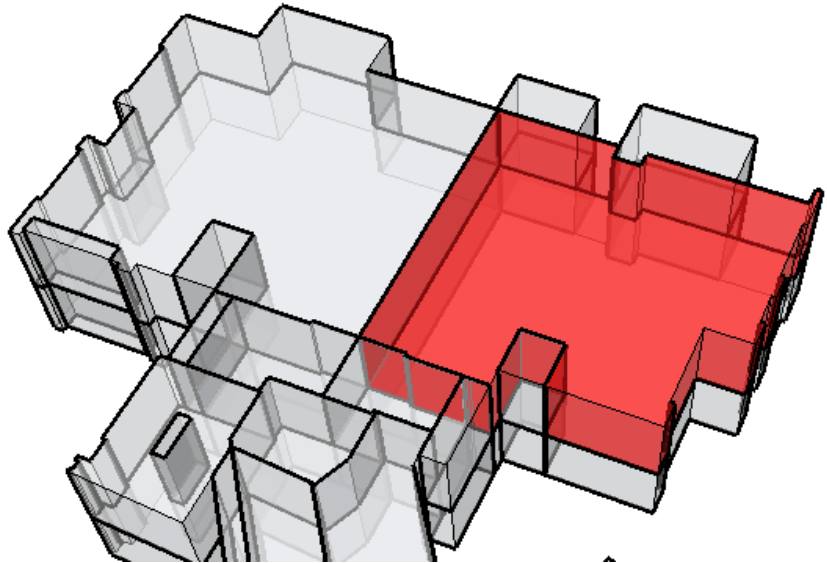
3D modeling of cadastral objects

- **Precise geometrics, consistent topological relationships**
- **Each 3D volume cadastral object is a closed 3D space represented by 3D geometry.**
- **Many solid modeling tools put the discrete faces together without inherent 3D structure to represent 3D geometries; most models look like “3D”.**
- **How to validate or guarantee its closeness?**

Database schema

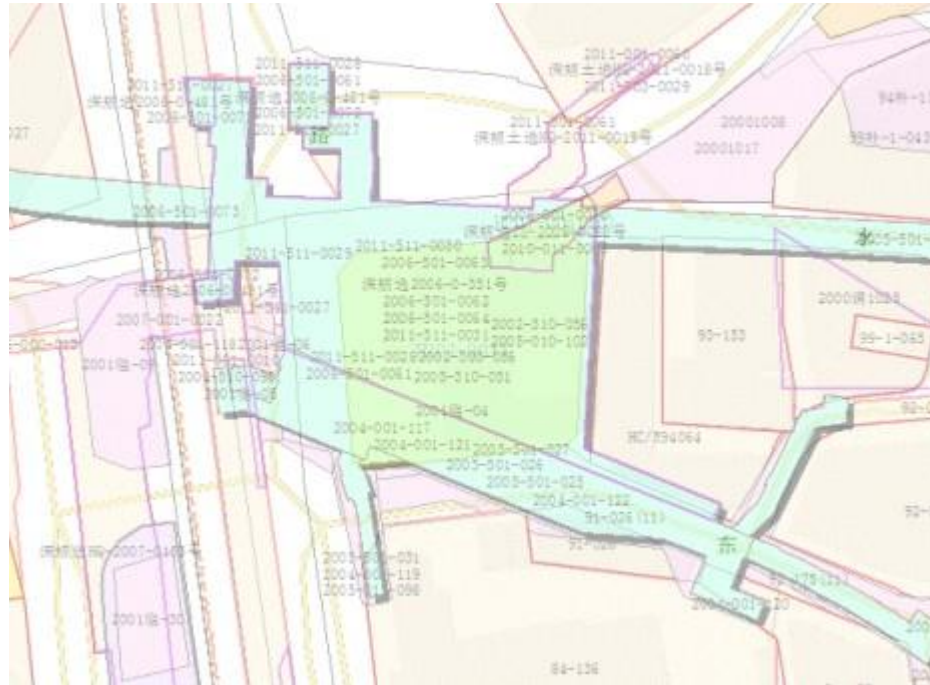


Topological query



4. Visualization

- Traditional 2D map cannot depict 3D cadastral objects clearly.



- Aim: show the location, context of 3D cadastral object and highlight them.



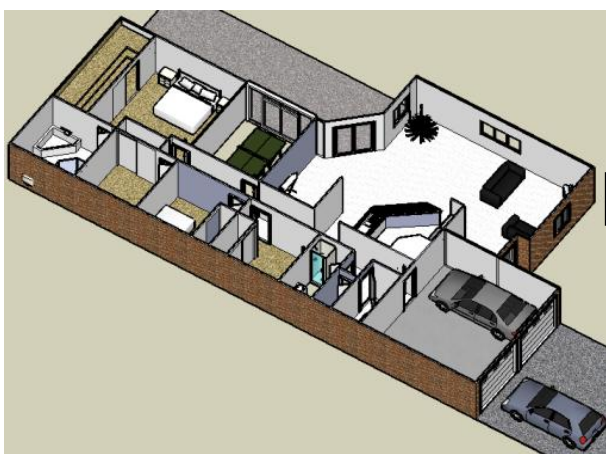
■ Visualization of virtual city/architecture



art



~~Unit?~~



functional division

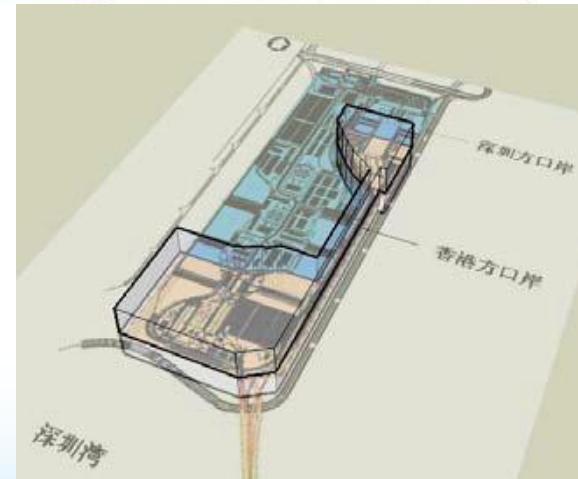
Physical appearance



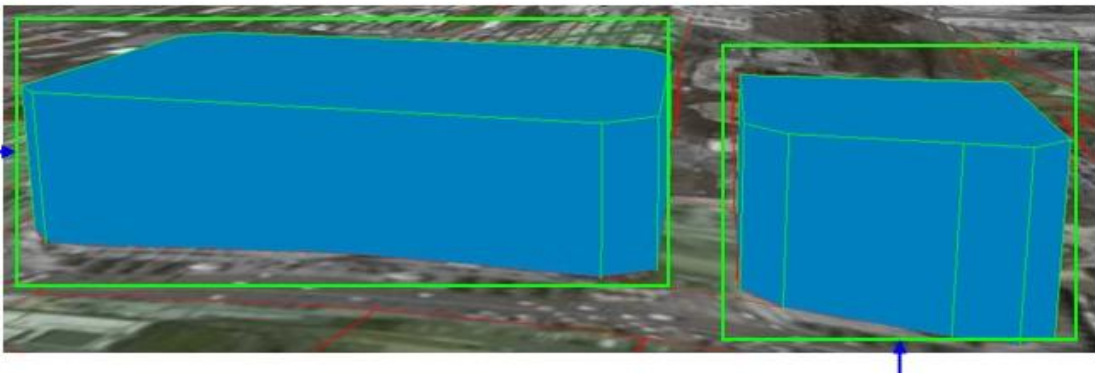
Visualization of 3D Cadastre

- **Show the precise boundary of property units and its 3D location.**
- **Its geospace may be delimited by the physical walls or fences.**
- **The visualizations of 3D cadastre illustrate the distributions of occupations and partitions of land space and urban space to give clear ideas for users or to support decision-making for the government.**

- The geometric boundaries of the 3D cadastral objects are the statutable or legal geographic surfaces, (a closed volume)



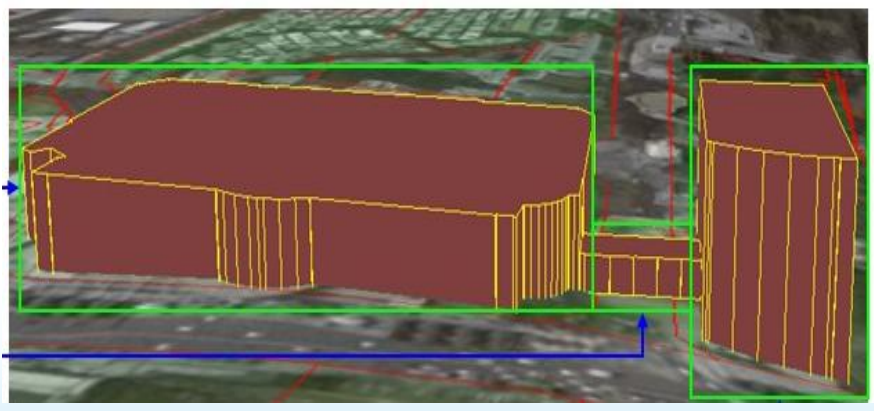
3D Land pace/ 3D building space

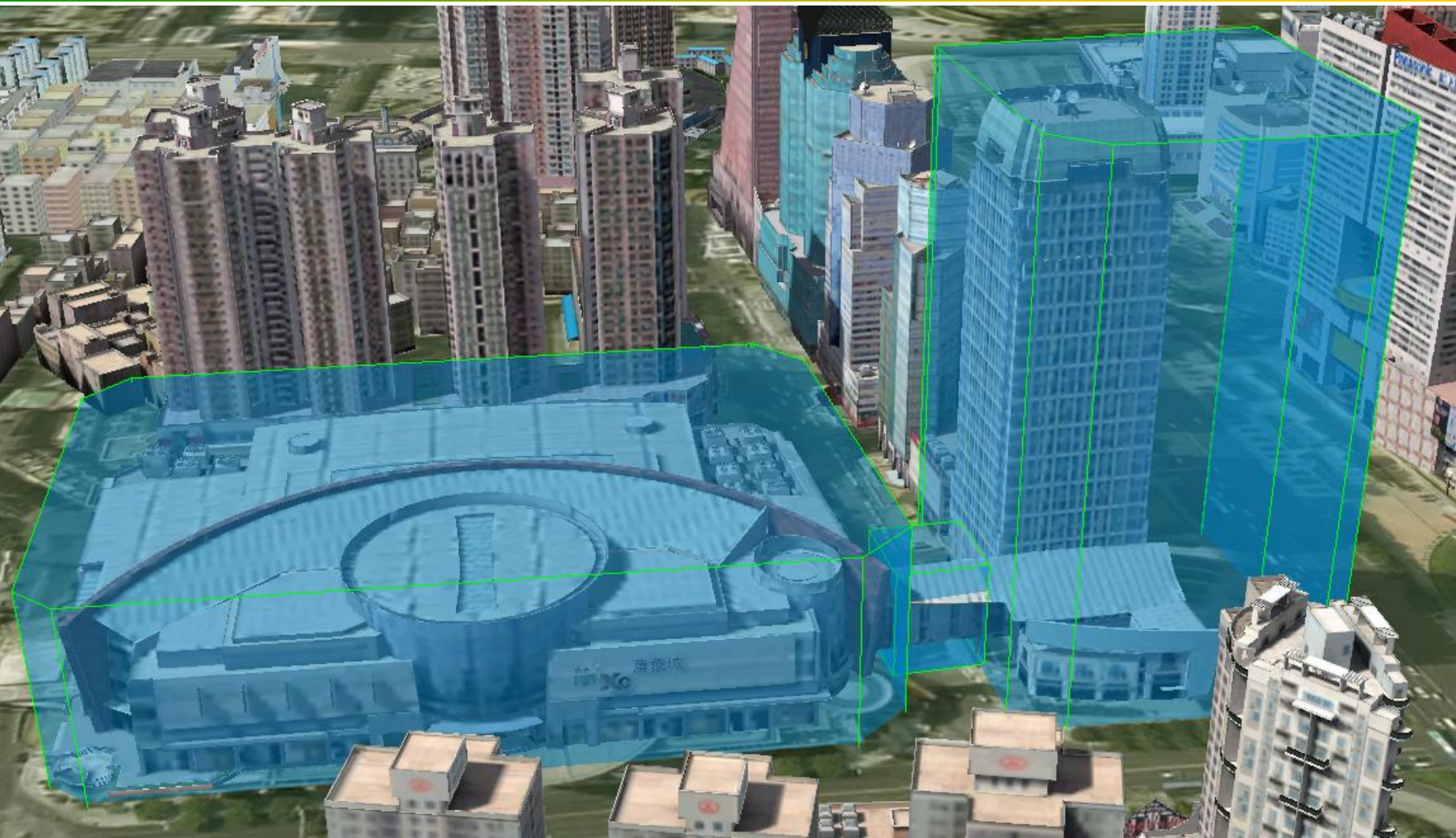


← 3D Land parcel

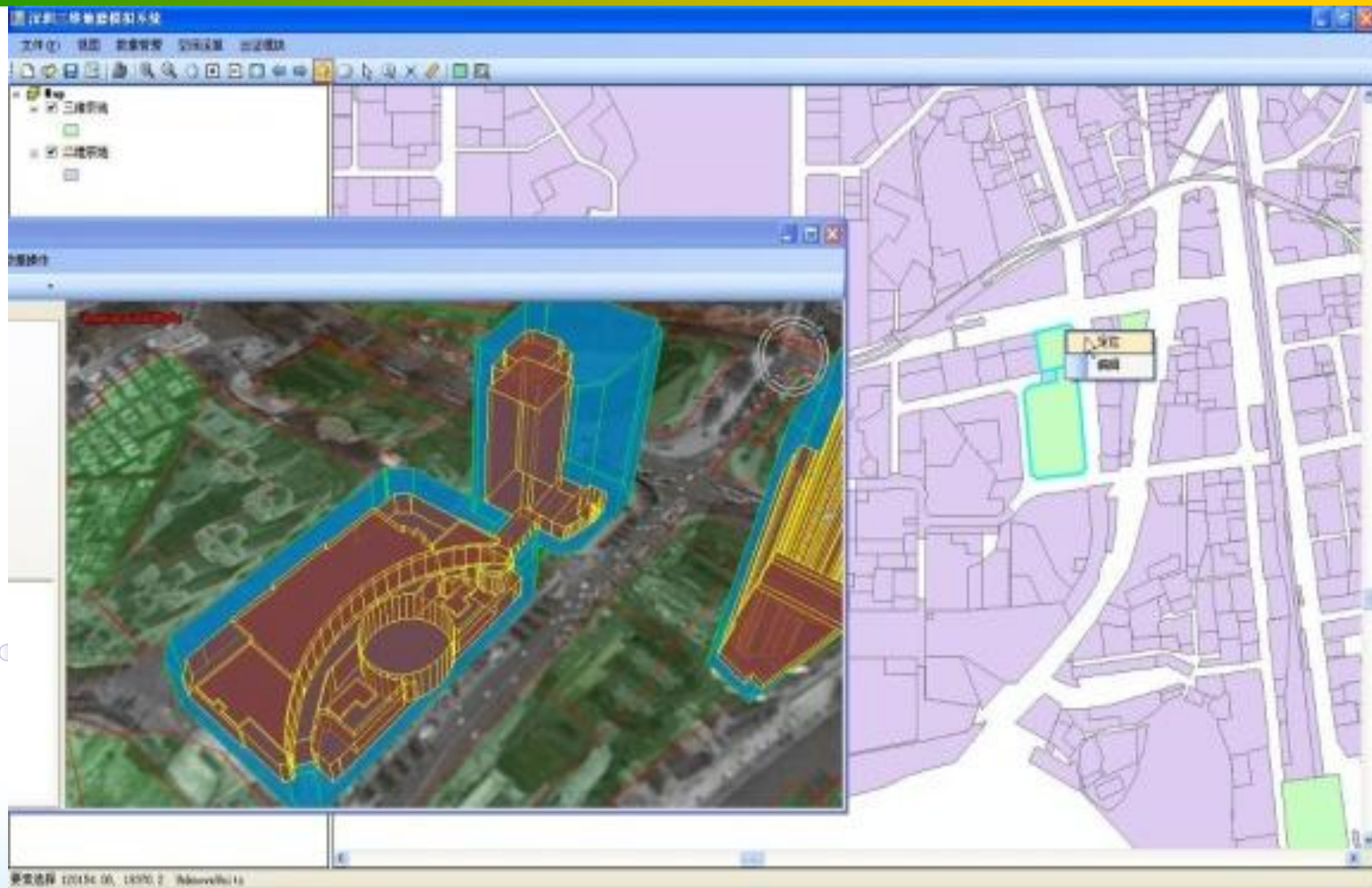


3D Building →

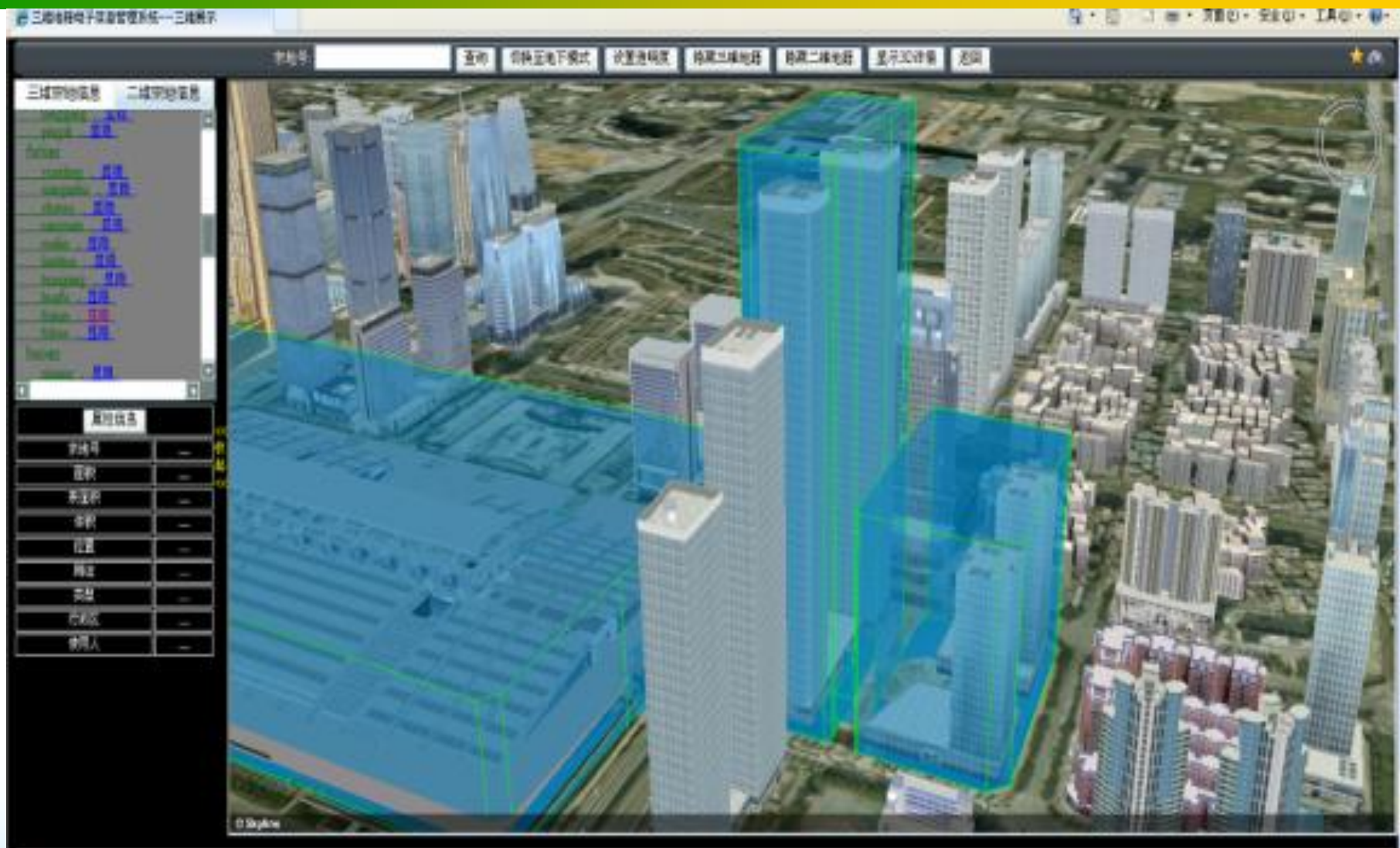




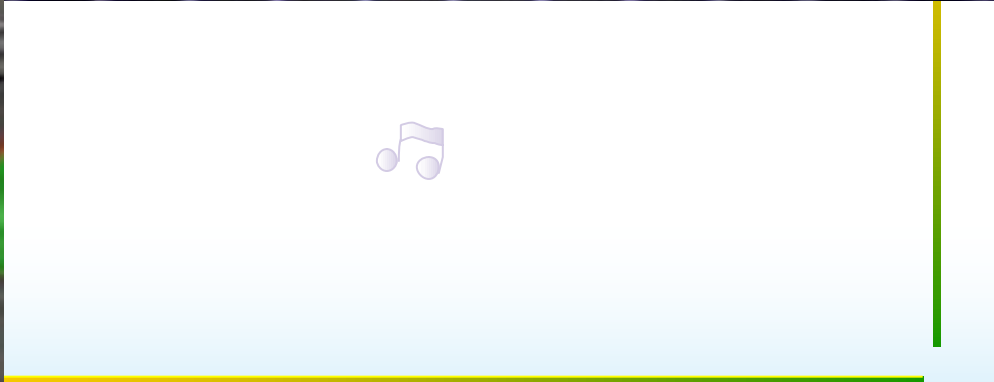
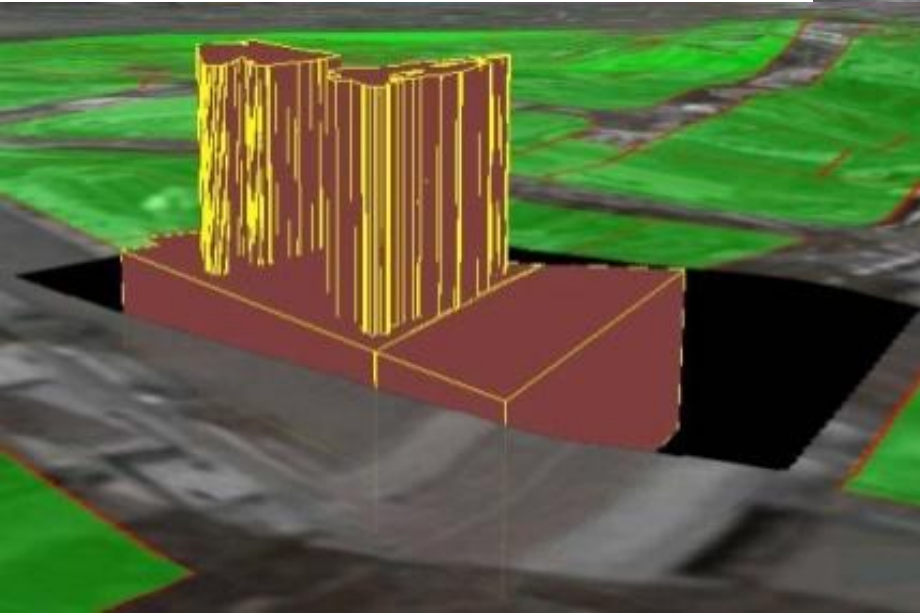
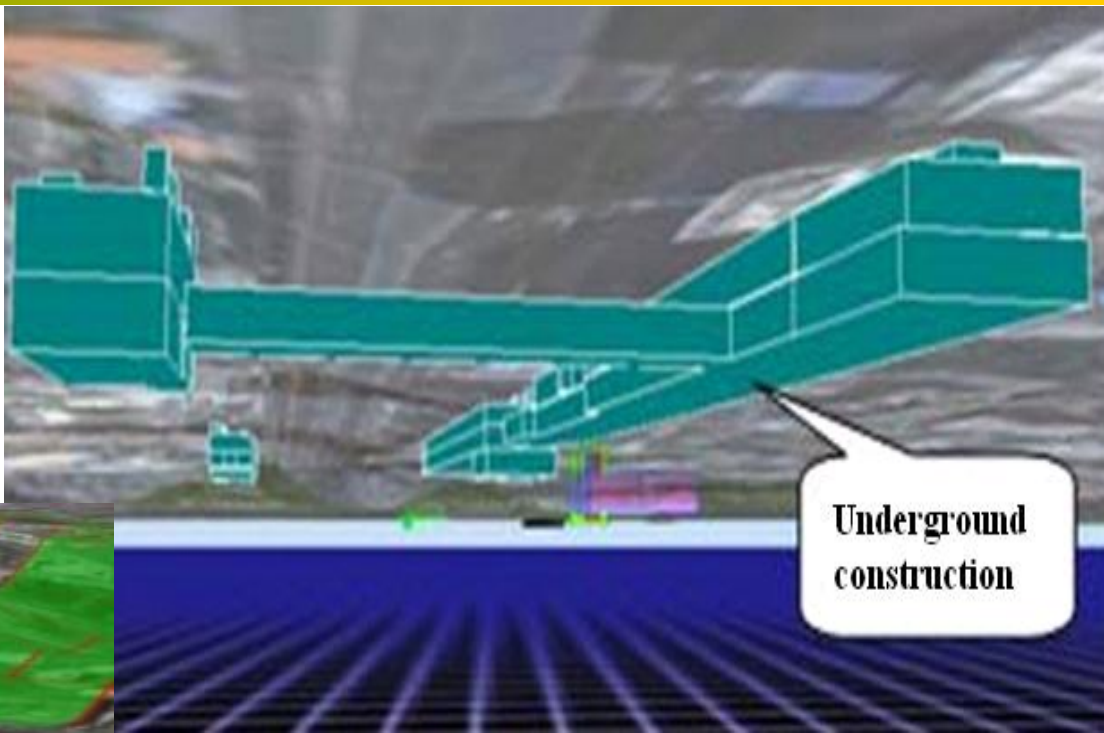
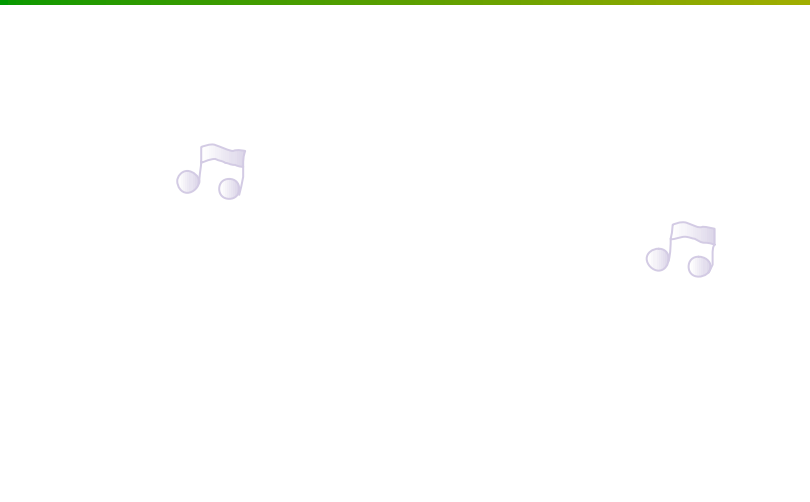
In-line visualization between 2D and 3D scenarios



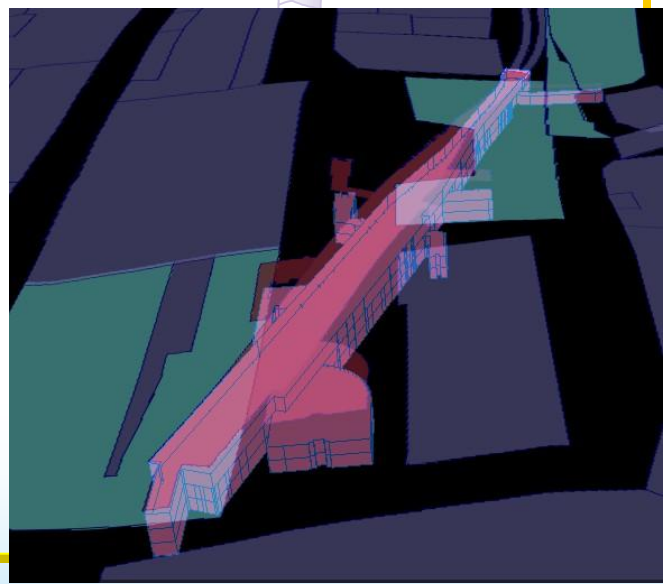
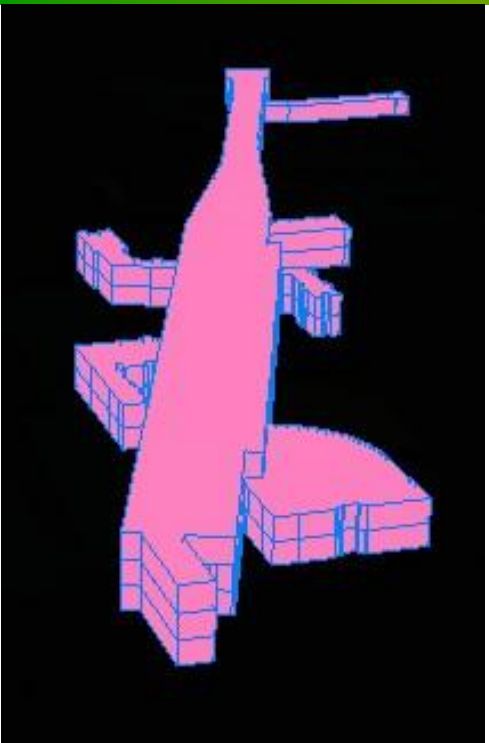
Visualization of 3D land space and 3D buildings



Underground mode

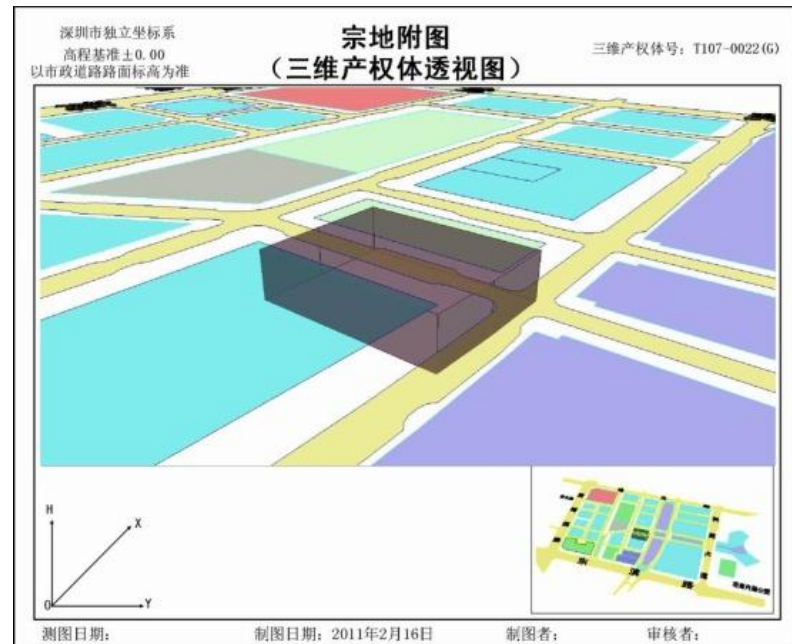
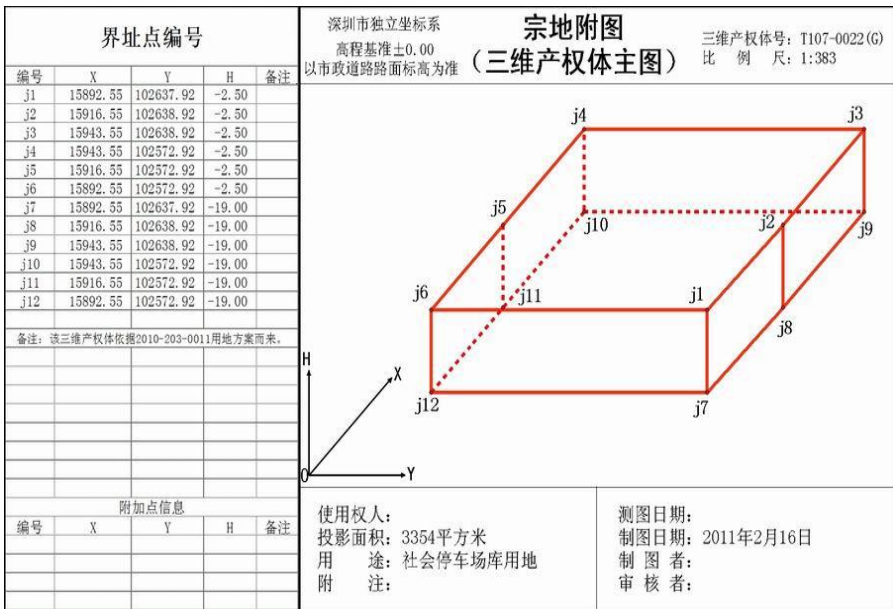


5. Application and Practice



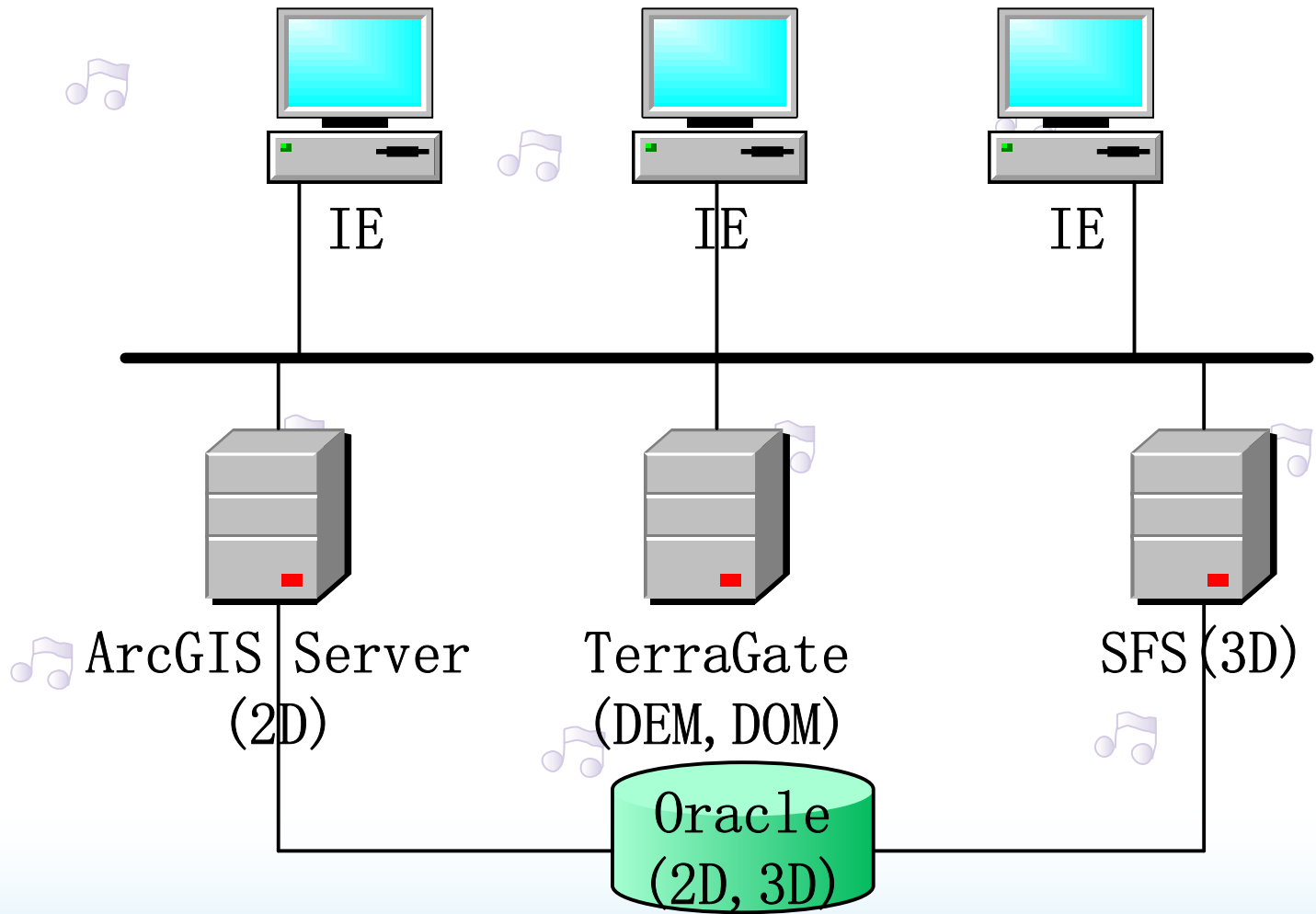
3D buffer and overlay

5. Application and Practice



A real 3D slot of a underground parking for auction

3D cadastre system



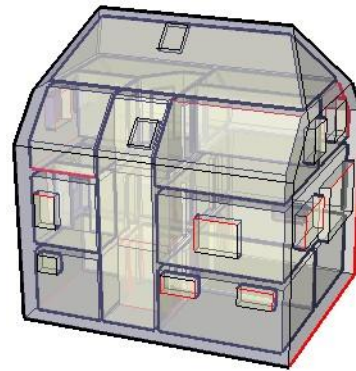
6. Conclusion

- A cadastral object is a combined feature in reality because it includes the natural entities (3D space).
- Also person and party, government and its authorization, as well 3Rs.
- 3D cadastral object becomes a **behavior-aware** 3D model because human actions are involved.



6. Discussion and Conclusion

- Through the representation and management, the cadastral model becomes **geometry-aware**.



- 3D cadastre integrates natural features with human beings and rights, and promotes the **harmony** of the society.

6. Discussion and Conclusion

- The paper describes the integration with 3D GIS in several aspects, including data modeling, visualization and practical applications.
- A long way to completely implement 3D cadastre, not only the technical problems, but also the legal and administrative issues.



Thank You !

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