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Development of Structure-based Topology of 3D Spatial Databases for Storing and Querying 3D Cadastre Cases

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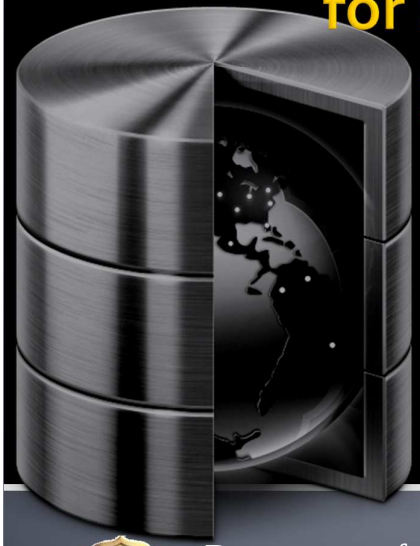
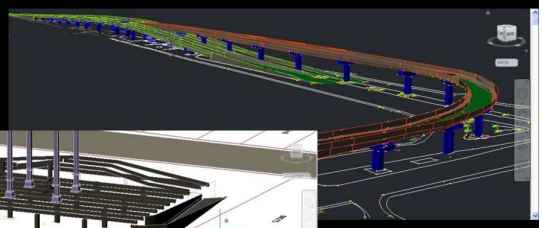
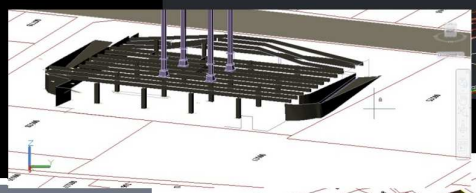
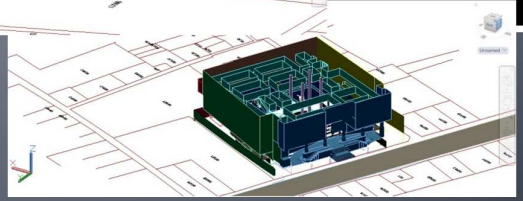
Trias Aditya









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Utilization of Space

- 2D representation for 3D objects registration:
  Appartment regsitration only, below and top of the land surface has not been regulated

Current Situation on 3D registration in Indonesia

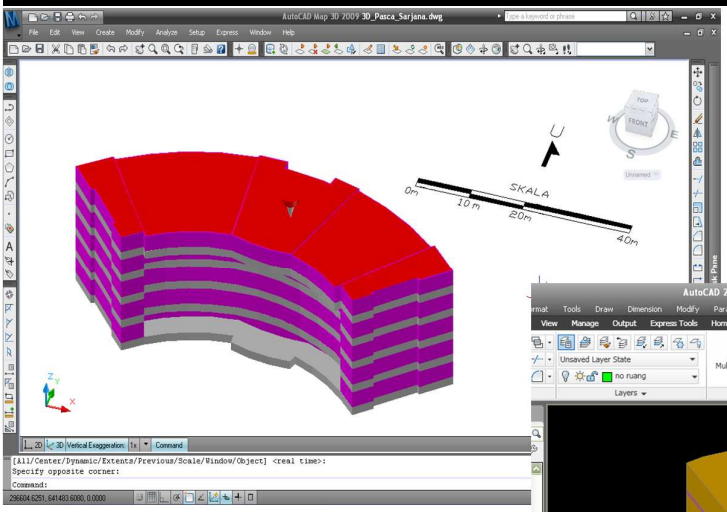
3D registration needs effective 3D spatial databases

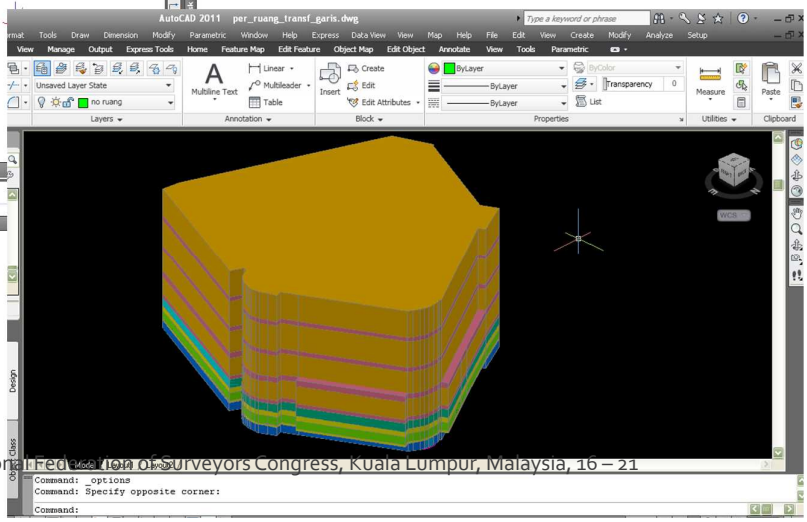
The Law on Apartment in 2011

Apartment

3D Cadastre

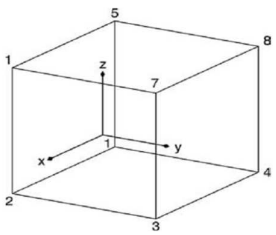
Visualization





3D Spatial Database

Geometry-based



Topology-based

BODY

BID	FID
1	1
1	2
1	3
1	4
1	5
1	6

FACE

FID	sdo_ordinate array
1 (lower face)	x4,y4,z4, x3,y3,z3, x2,y2,z2, x1,y1,z1, x4,y4,z4
2 (side 1)	x3,y3,z3, x4,y4,z4, x8,y8,z8, x7,y7,z7, x3,y3,z3
3 (side 2)	x4,y4,z4, x1,y1,z1, x5,y5,z5, x8,y8,z8, x4,y4,z4
4 (side 3)	x1,y1,z1, x2,y2,z2, x6,y6,z6, z5,y5,z5, x1,y1,z1
5 (side 4)	x3,y3,z3, x2,y2,z2, x6,y6,z6, z7,y7,z7, x3,y3,z3
6 (upper face)	x5,y5,z5, x6,y6,z6, x7,y7,z7, z8,y8,z8, x5,y5,z5

- Hypothesis
- To increase data quality and data consistency
- Execution time of spatial operation faster

Data

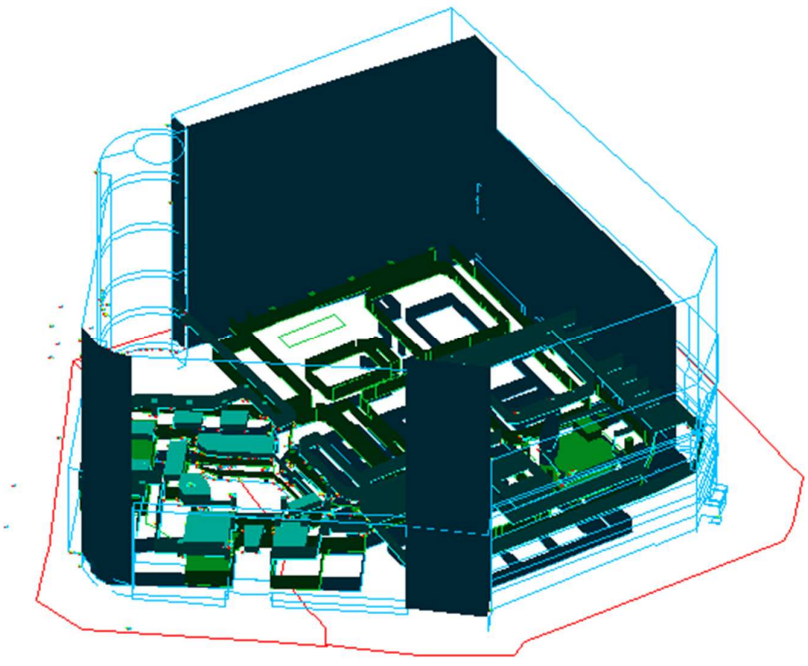
- Spatial Data of Rusun Plasa Simpanglima Semarang.
  - 3D coordinates (X, Y, Z)
  - Format : CAD
  - Reference Coordinate System : Universal Transverse Mercator (UTM)
  - Survey Instrument : Total Station (TS) Leica reflectorless TCR805
  - Years of Measurement : 2011
- Attribute Data of Rusun Plasa Simpanglima Semarang

Methods

Phases of the Data Analysis

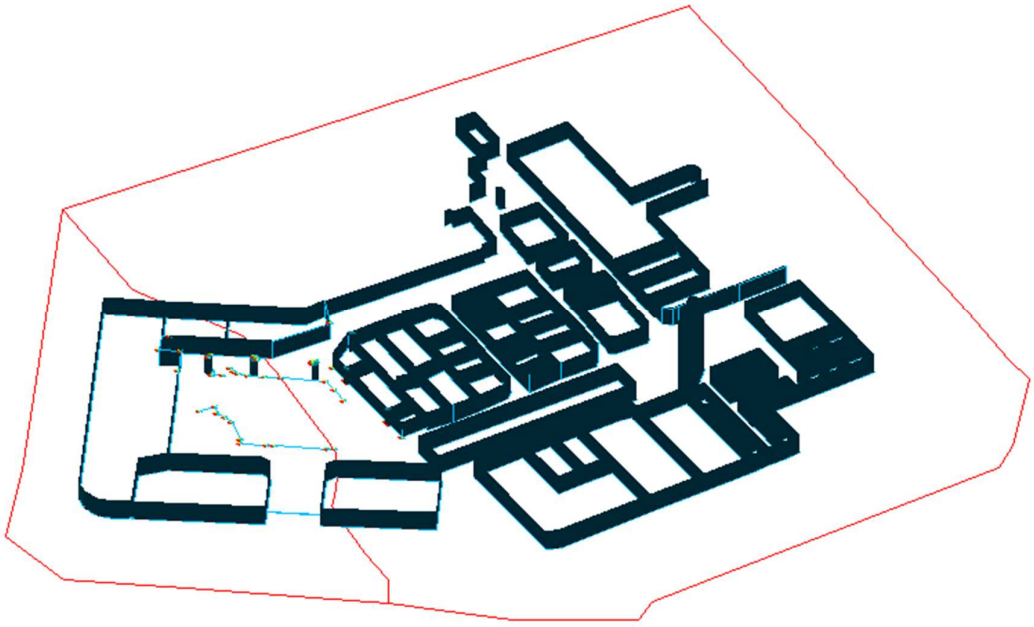
1. Spatial Data Editing
2. Spatial Data Storing into PostgreSQL
3. Creating Tables and Updating the Database Attribute
4. Development of the Topology-Based Structure
5. Analyses

1. Spatial Data Editing… (I)



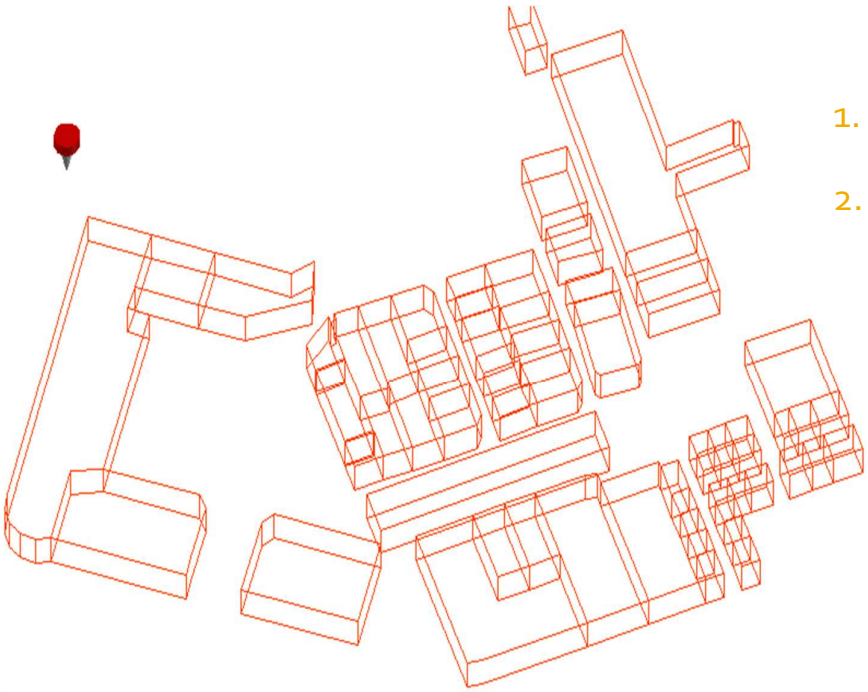
Rusun Plasa Simpanglima

1. Spatial Data Editing … (II)



First Floor of the Rusun Plasa Simpanglima

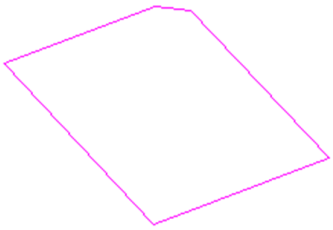
1. Spatial Data Editing … (III)



1. Boundary Parcel
2. Rooms

2. Spatial Data Storing into PostgreSQL … (I)

I. Importing Spatial Data into KML Format

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43            <LineString>
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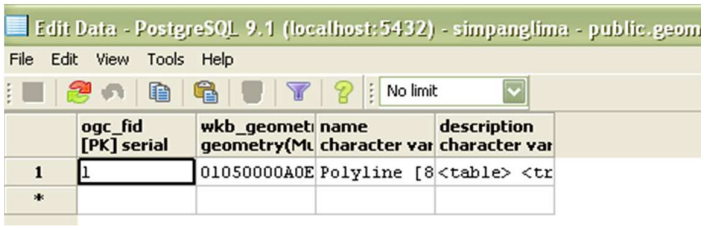
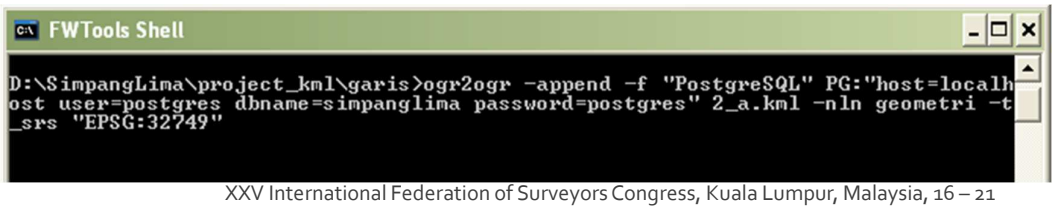
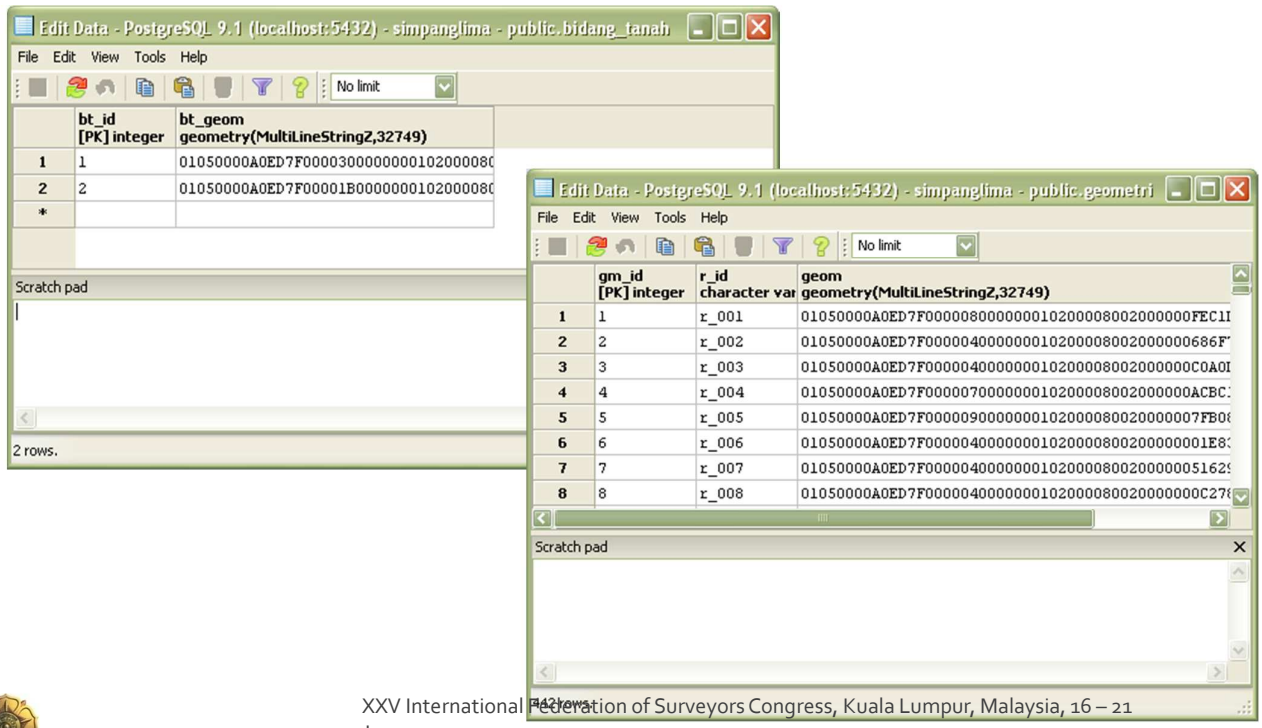
2. Spatial Data Storing into PostgreSQL … (II)

II. Conversion KML Format into PostgreSQL

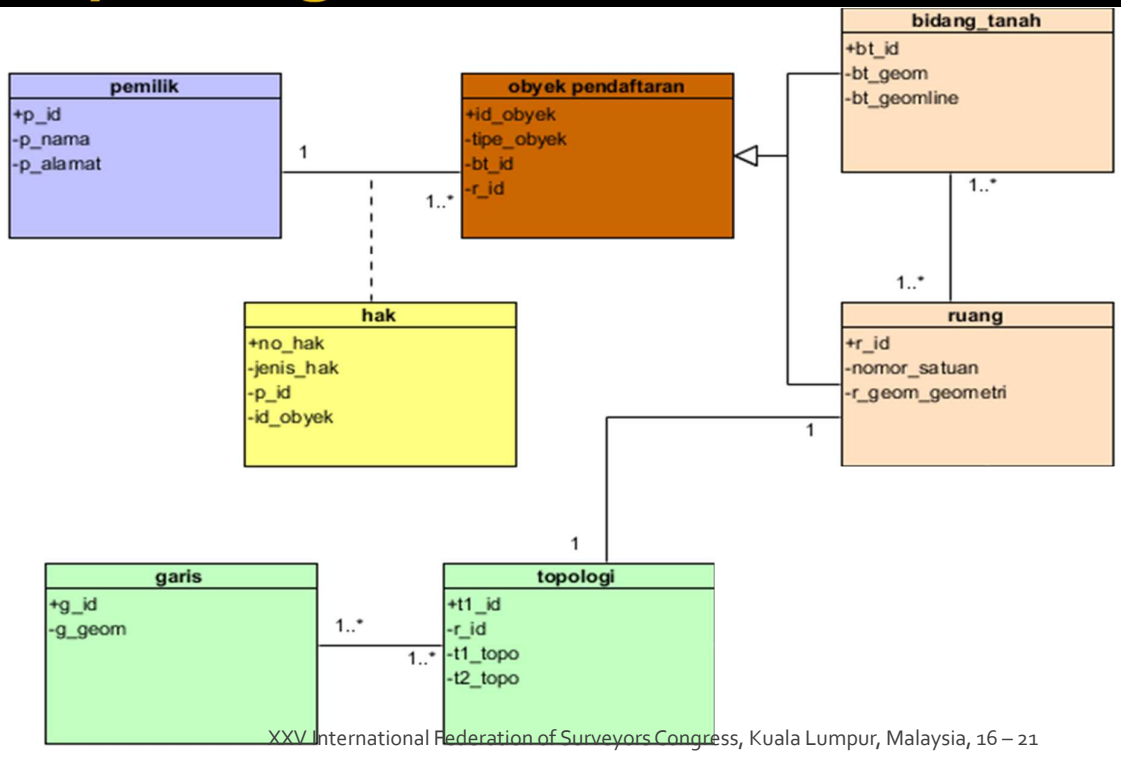




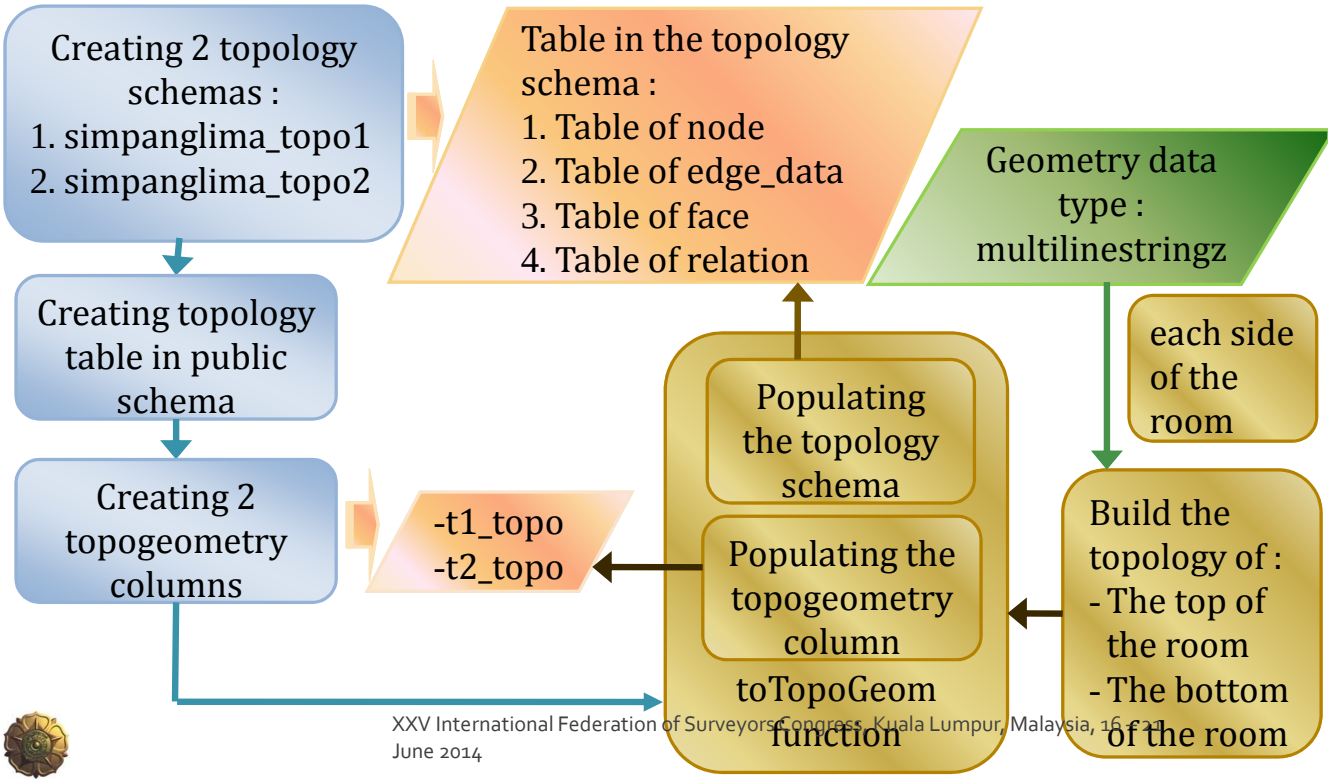
2. Spatial Data Storing into PostgreSQL … (III)



3. Creating Table and Updating Database Attribute

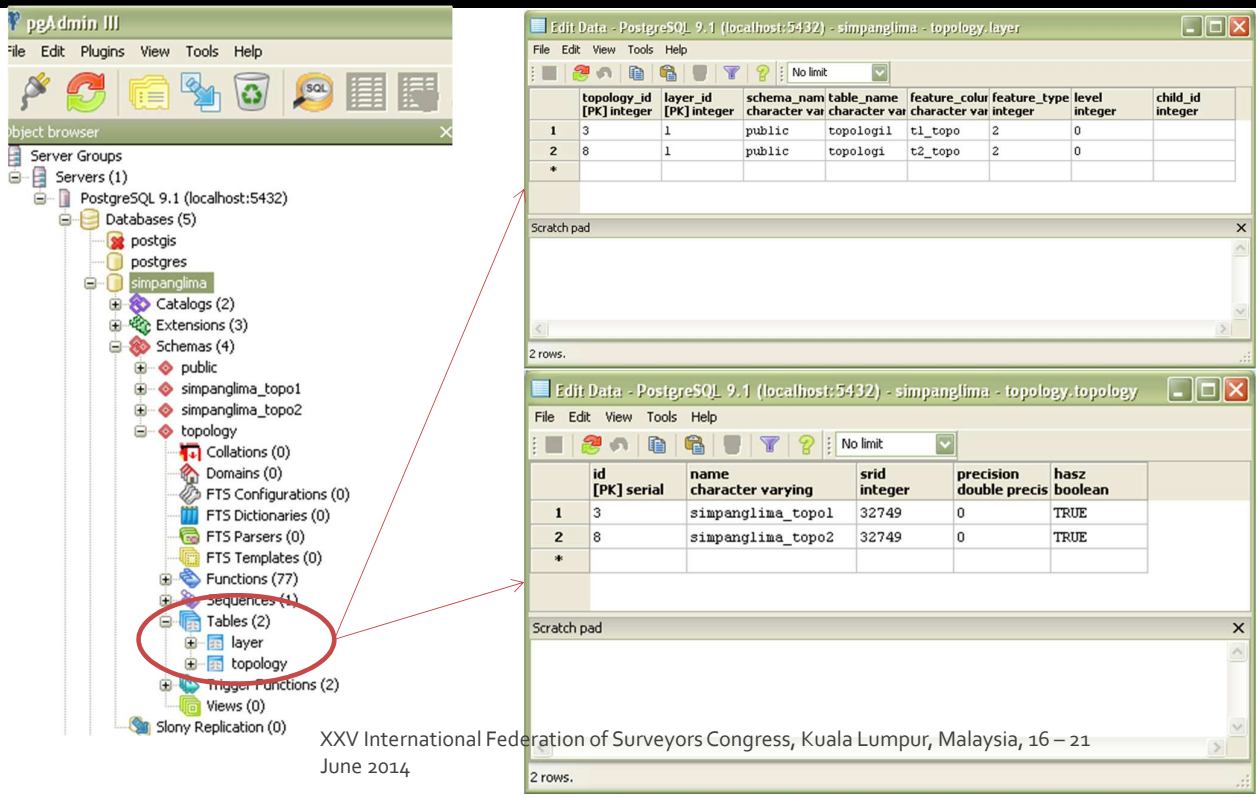


4. Development of the Topology-based Structure

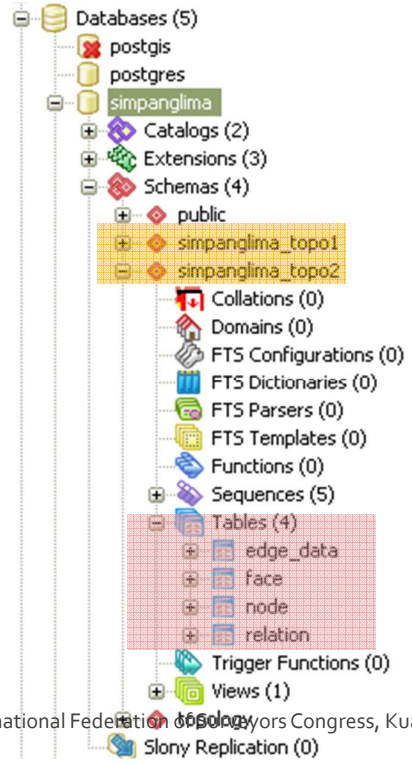


Results

Topology-Based Structure Database … (I)



Topology-Based Structure Database … (II)



Topology-Based Structure Database … (III)

Edit Data - PostgreSQL 9.1 (localhost:5432) - simpanglima - simpanglima_topo1.node

File Edit View Tools Help

No limit

	node_id [PK] serial	containing_fa integer	geom geometry(Po
1	1		01010000A0E
2	2		01010000A0E
3	3		01010000A0E
4	4		01010000A0E
5	5		01010000A0E
6	6		01010000A0E

Scratch pad

192 rows.

Topology-Based Structure Database … (IV)

Edit Data - PostgreSQL 9.1 (localhost:5432) - simpanglima - simpanglima_topo1.edge_data

File Edit View Tools Help

No limit

	edge_id [PK] ser	start_node integer	end_node integer	next_left integer	abs_next_left integer	next_right integer	abs_next_right integer	left_face integer	right_face integer	geom geometry(LineStringZ,32749)
1	1	1	2	2	2	-8	8	0	1	01020000A0ED7F0000020000
2	2	2	3	9	9	-1	1	0	1	01020000A0ED7F0000020000
3	3	3	4	4	4	-2	2	2	1	01020000A0ED7F0000020000
4	4	4	5	-10	10	-3	3	2	1	01020000A0ED7F0000020000
5	5	5	6	11	11	-4	4	3	1	01020000A0ED7F0000020000
6	6	6	7	-17	17	-5	5	4	1	01020000A0ED7F0000020000
7	7	7	8	8	8	-6	6	0	1	01020000A0ED7F0000020000
8	8	8	1	1	1	-7	7	0	1	01020000A0ED7F0000020000
9	9	3	9	-12	12	3	3	0	2	01020000A0ED7F0000020000
10	10	9	5	5	5	-9	9	3	2	01020000A0ED7F0000020000

Scratch pad

241 rows.

Topology-Based Structure Database … (V)

Edit Data - PostgreSQL 9.1 (localhost:5432) - simpanglima - simpanglima_topo…

File Edit View Tools Help

No limit

	face_id [PK] serial	mbr geometry(Polygon,32749)
1	0	
2	1	0103000020ED7F0000010000000500000
3	2	0103000020ED7F0000010000000500000
4	3	0103000020ED7F0000010000000500000
5	4	0103000020ED7F0000010000000500000
6	5	0103000020ED7F0000010000000500000
7	6	0103000020ED7F0000010000000500000

Scratch pad

65 rows.

Topology-Based Structure Database … (VI)

Edit Data - PostgreSQL 9.1 (localhost:5432) - simpanglima - simpanglima_topo…

File Edit View Tools Help

No limit

	topogeo_id integer	layer_id integer	element_id integer	element_typ integer
1	1	1	4	2
2	1	1	6	2
3	1	1	1	2
4	1	1	2	2
5	1	1	3	2
6	1	1	7	2
7	1	1	5	2
8	1	1	8	2
9	2	1	9	2
10	2	1	3	2
11	2	1	10	2
12	2	1	4	2
13	3	1	11	2

Scratch pad

316 rows.

Edit Data - PostgreSQL 9.1 (localhost:5432) - simpanglima - public.topologi

File Edit View Tools Help

No limit

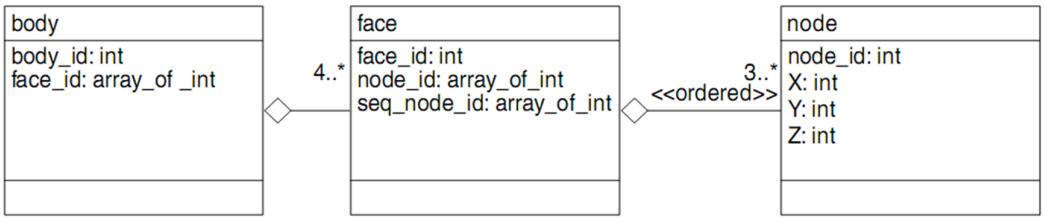
	t1_id [PK] integer	r_id character var	t1_topo topogeometry	t2_topo topogeometry
1	1	r_001	(3,1,1,2)	(8,1,1,2)
2	2	r_002	(3,1,2,2)	(8,1,2,2)
3	3	r_003	(3,1,3,2)	(8,1,3,2)
4	4	r_004	(3,1,4,2)	(8,1,4,2)
5	5	r_005	(3,1,5,2)	(8,1,5,2)
6	6	r_006	(3,1,6,2)	(8,1,6,2)
7	7	r_007	(3,1,7,2)	(8,1,7,2)
8	8	r_008	(3,1,8,2)	(8,1,8,2)
9	9	r_009	(3,1,9,2)	(8,1,9,2)
10	10	r_010	(3,1,10,2)	(8,1,10,2)

Scratch pad

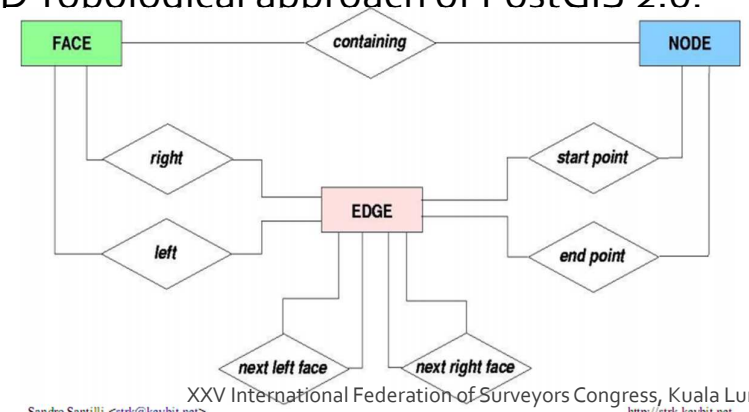
10 rows.

Topology-based structure

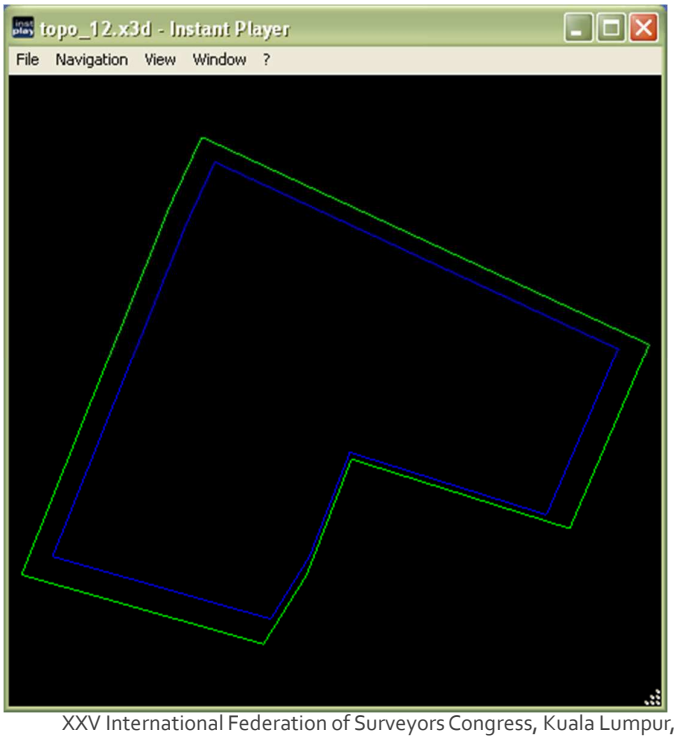
- The relationship:



- 2.5 D Topological approach of PostGIS 2.0:



Topology-Based Structure Database … (VII)



Analyses

Analyses of Real Cadastre Case … (I)

From 12 possible cases, 5 cases that can be resolved

Case 1 : Shows the room which is directly adjacent to a specified room (in a horizontal direction).

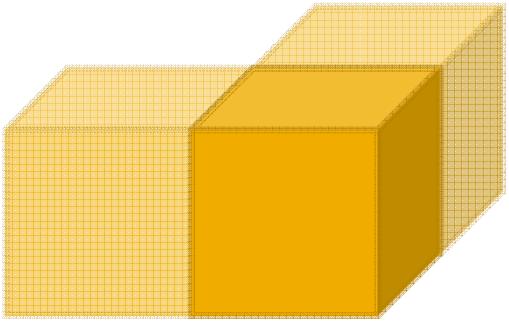
Case 3 : Indicate in which land parcel the room on the first floor was located.

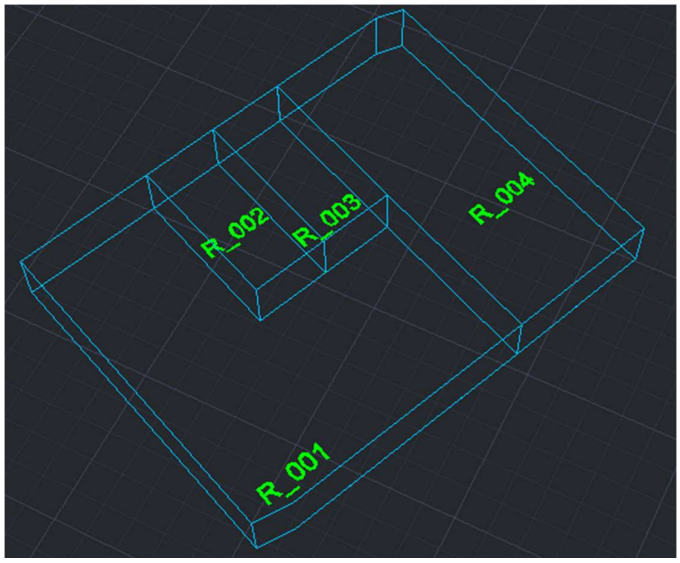
Case 5 : Inform rooms on the first floor that their entire room floor are above a certain land parcel.

Case 7 : Mention rooms on the first floor which is above the two land parcels at once.

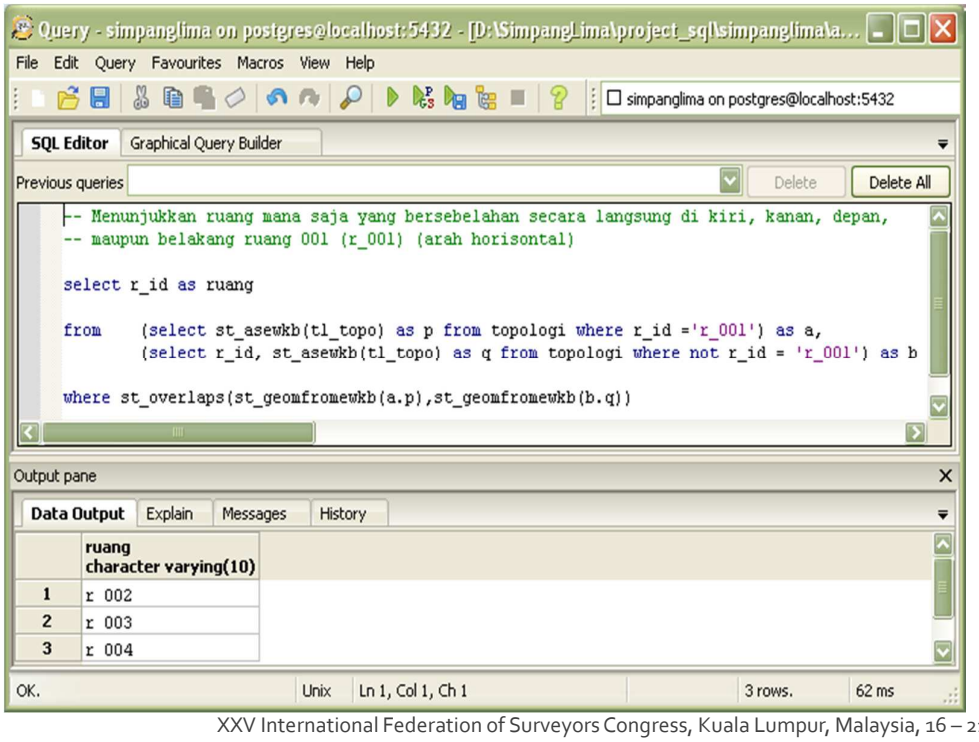
Case 9 : Shows the line geometry that is the boundary of the wall directly adjacent to or shared with in a horizontal direction.

Case 1

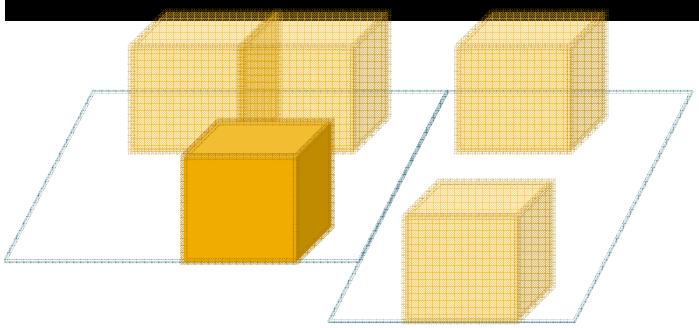


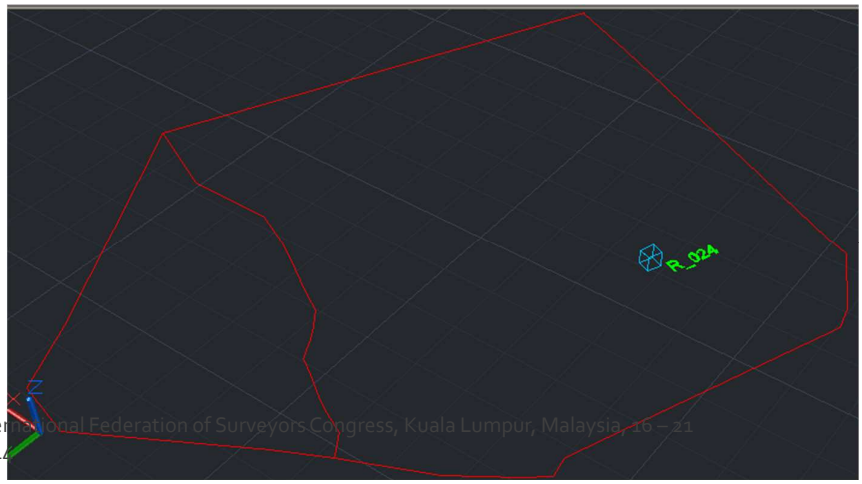


Analyses of Real Cadastre Case … (II)
:: Resolving Case 1 ::

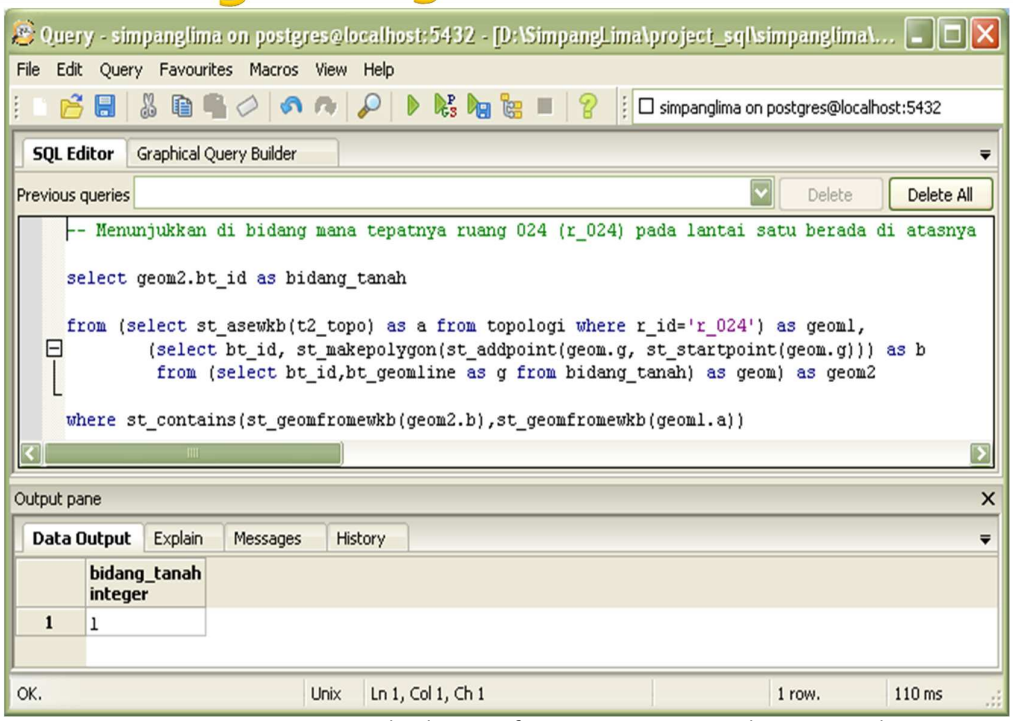


Case 3

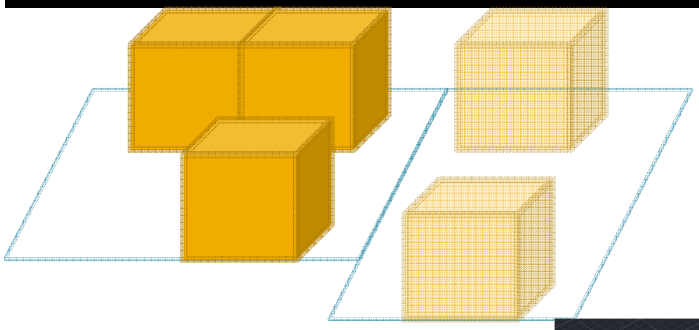


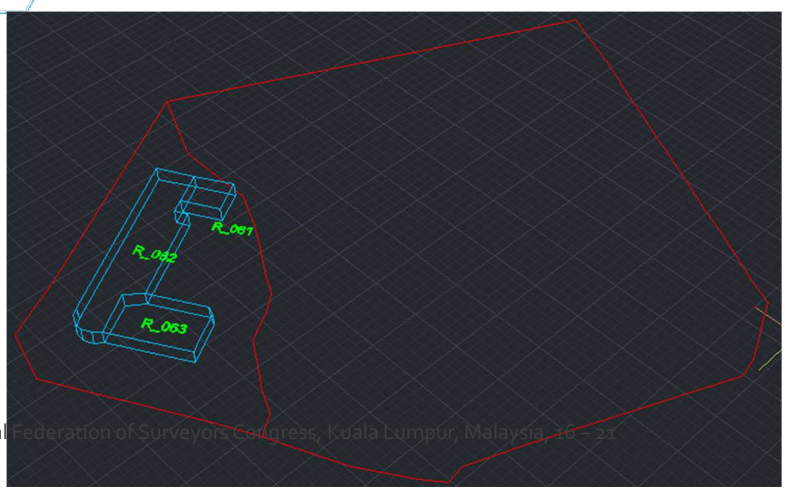


Analyses of Real Cadastre Case … (III)
:: Resolving Case 3 ::

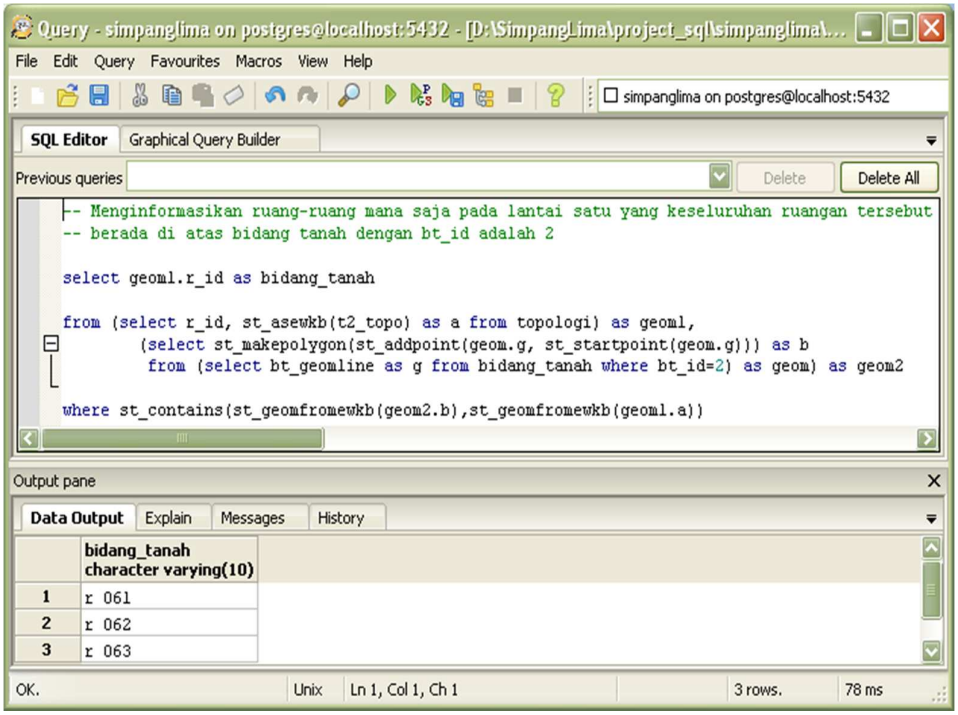


Case 5

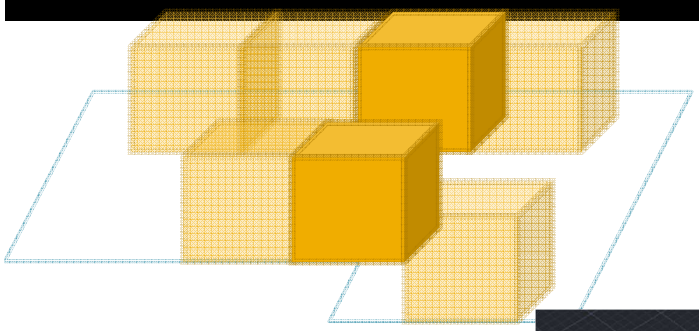


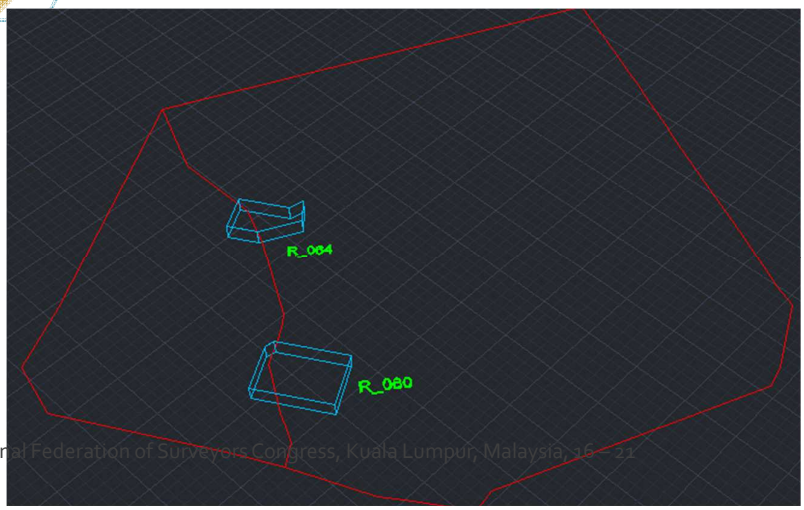


Analyses of Real Cadastre Case … (IV)
:: Resolving Case 5 ::

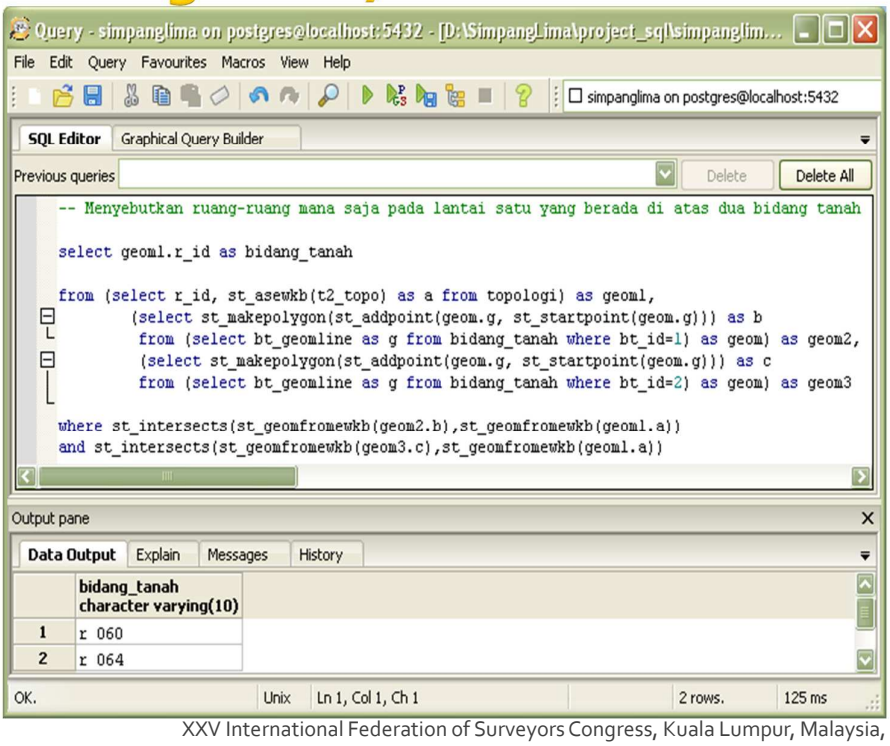


Case 7

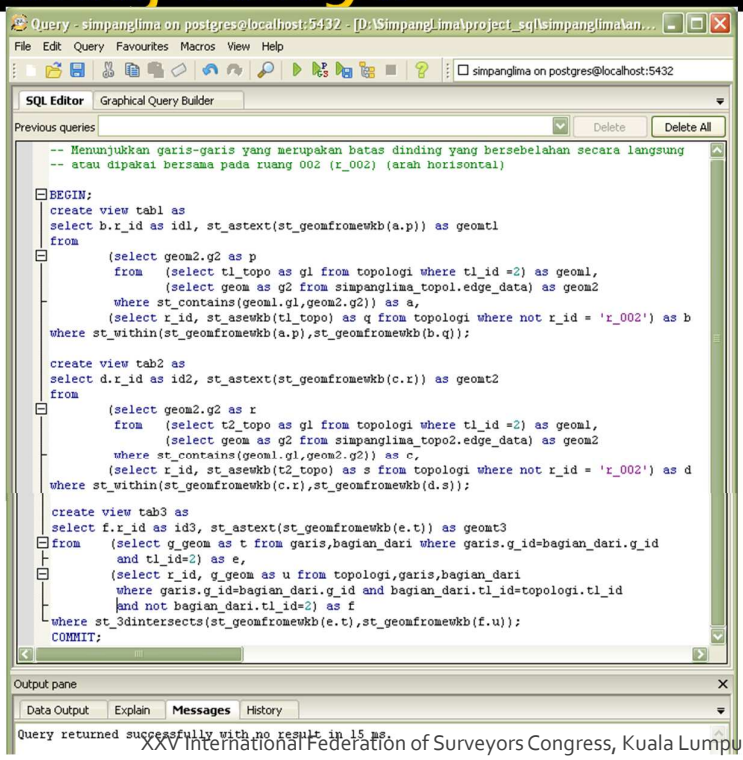




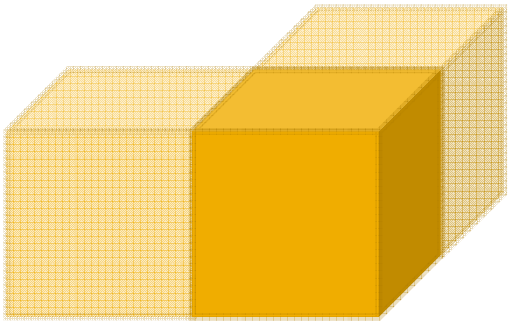
Analyses of Real Cadastre Case … (V)
:: Resolving Case 7 ::

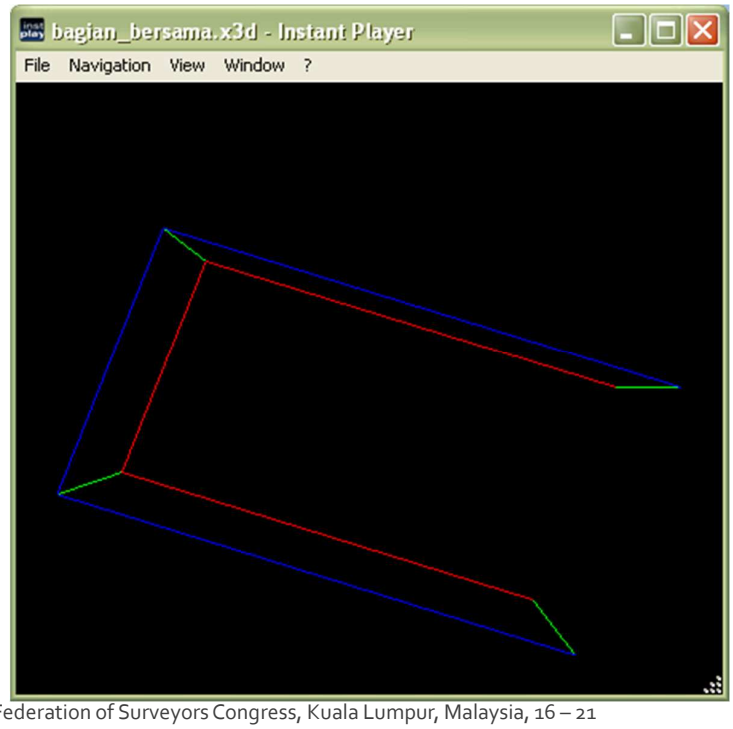


Analyses of Real Cadastre Case … (VI)
:: Resolving Case 9 ::

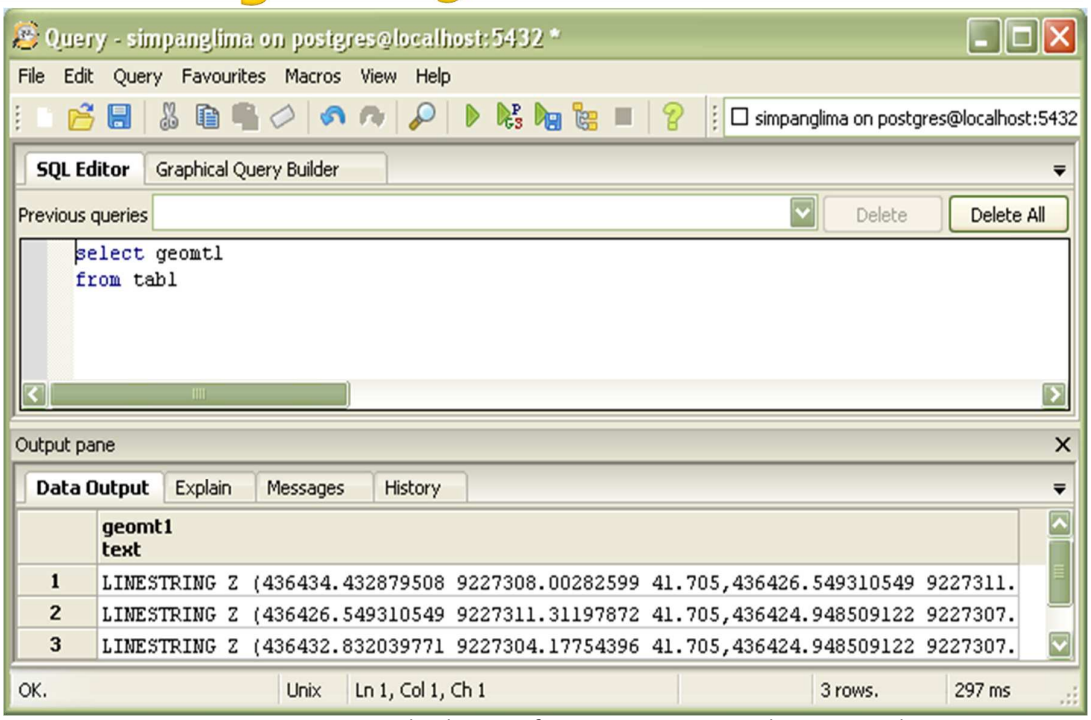


Case 9

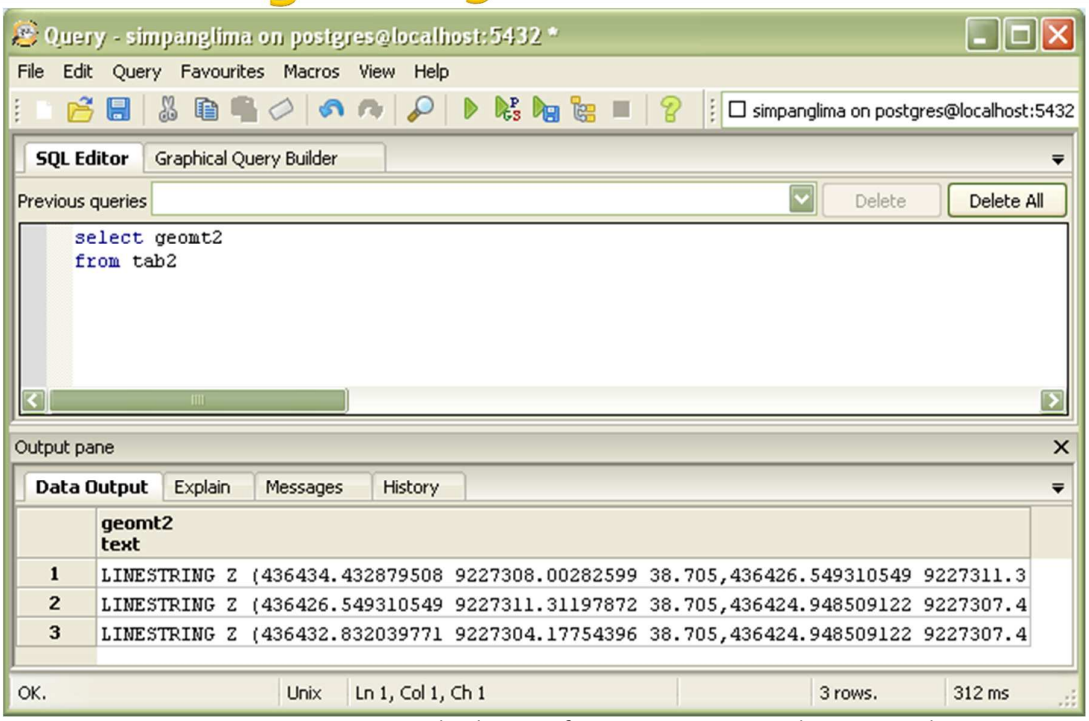




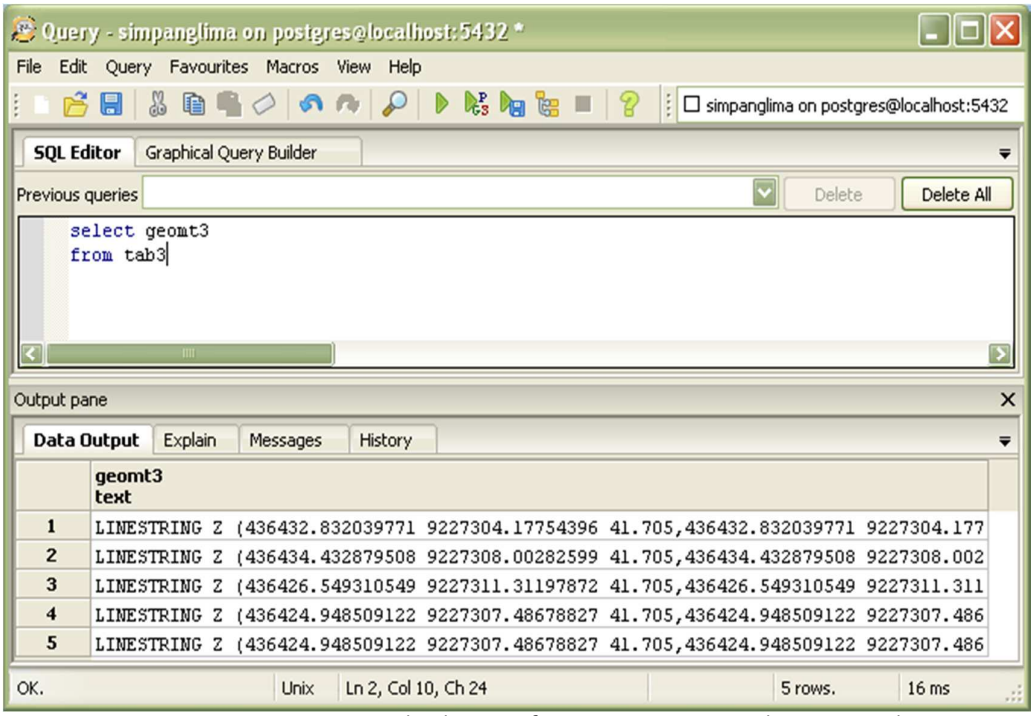
Analyses of Real Cadastre Case … (VII)
:: Resolving Case 9 ::



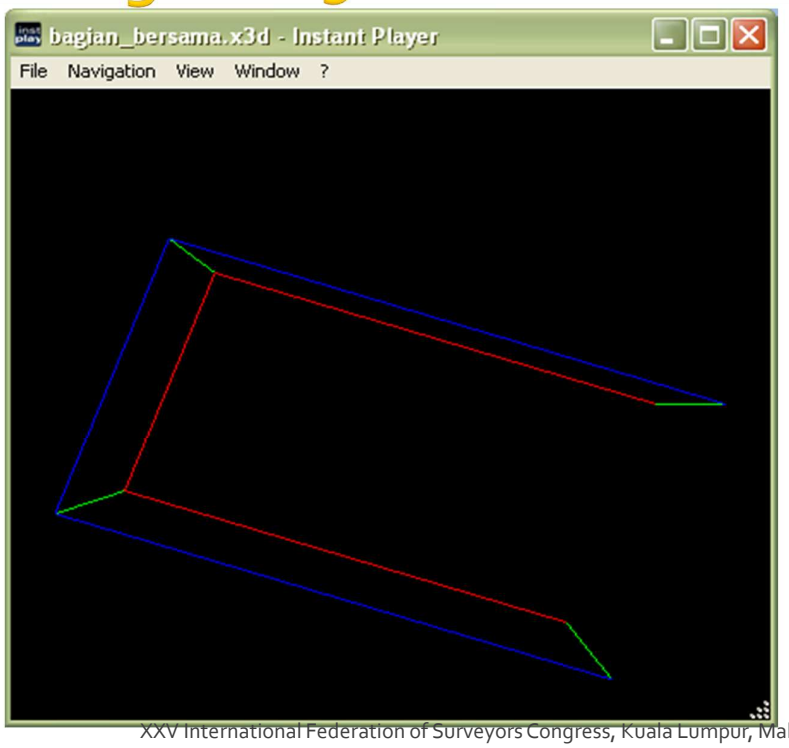
Analyses of Real Cadastre Case … (VIII)
:: Resolving Case 9 ::



Analyses of Real Cadastre Case … (IX)
:: Resolving Case 9 ::



Analyses of Real Cadastre Case … (X)
:: Resolving Case 9 ::



Conclusions

1. The topology-based data structure is not capable of describing the object as a whole space either as a solid or as a skeleton-shaped object.

2. 3D spatial database can provide information in relation to space (one space next to other space), indicate underlying land, inform the entire space above the ground plane, show a space located above two parcels, and exhibit adjacent spaces.

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THANK YOU