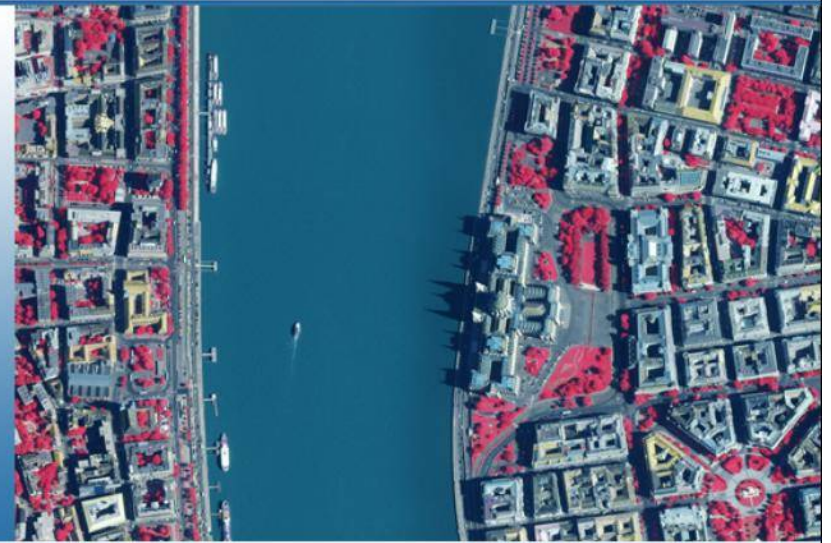




## 3D Cadastre Development in Hungary

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2nd International Workshop on 3D Cadastres

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# Hungary



- **Area: 93 000 sqkm**
- **Population: 10 million**
- **Cadastre&Land Registry:**
  - **No. Of Parcels: 7,6 million**
  - **No. Of Properties: 10 million**



# Cadastral & Land Registry

- All Lands and Properties have been registered since the end of the XIX. Century (Austro-Hungary)
- Condominium registration started at the beginning of 1930's
- Land Registry and Cadastral Mapping has continuously operated during the communist ages, as well
- In 1972 a Unified Land Registry System introduced, in which cadastral mapping and land registration belong to the same organization, Land Offices. Unified Land Registry System is a Title Registry
- In 1996 Standard MSZ 7772-1, Digital Base Map, Conceptual Model introduced
- In 2000, a new Land Registry IT system introduced (TAKAROS) for the management of Legal Data
- From 2003 Land Registry Services via Internet (TAKARNET) is available
- In 2009 a new, integrated IT system (DATR) implemented for both legal and cadastral map data management
- All these development based on the Standard above, and carried out by FÖMI (both professional and IT side)



# Legal Framework

- Governmental regulations determined Cadastre and Land Registry till 1996
- In 1996 the Act on Surveying and Mapping Activities went into force as the first Act level regulation on Cadastre
- In 1997 the Act on Land Registry went into force
- Until 2011 these two Acts influenced mainly the Hungarian Unified Registry
- Because of the technical and IT developments it was decided in 2011, a new Act on Surveying and Mapping Activities should be introduced, including 3D Cadastre issues, together with the modification of Act on Land Registry

# New 3D registration of objects



Constructions



Utilities



Arable Land



Public Land



Private Land, Buildings



OIP



Condominiums



Utilities



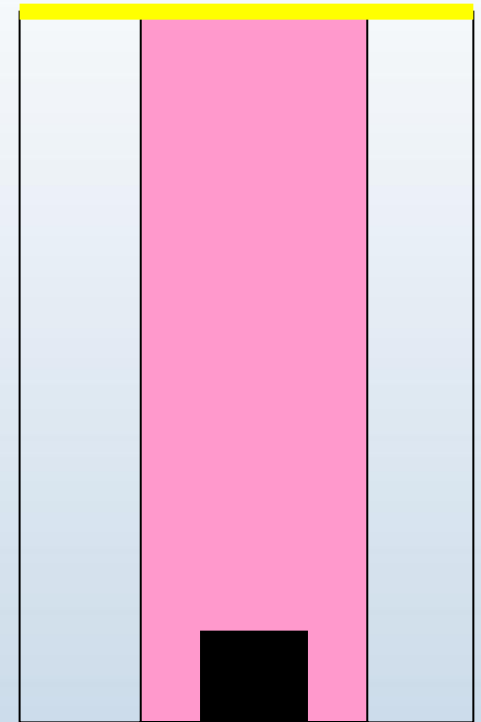
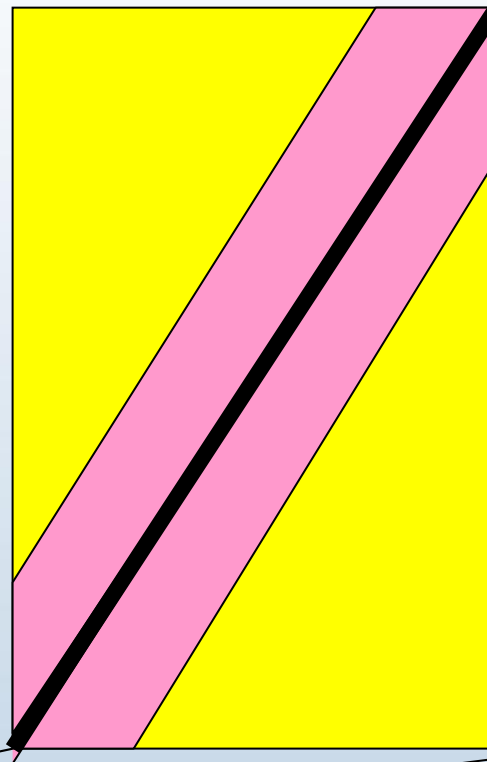
Constructions

# Concept of Registration of 3D situations



## Land registry

- Registering the object on legal side (Land record)
- Registering the object on geometric side (Cadastral database) as it is
- Calculation of required legal space
- Link the objects with the appropriate legal space
- Registering the rights, related to legal space



### Land record

- ID
- ownership
- mortgages etc.

Link 1  
Utility->LS

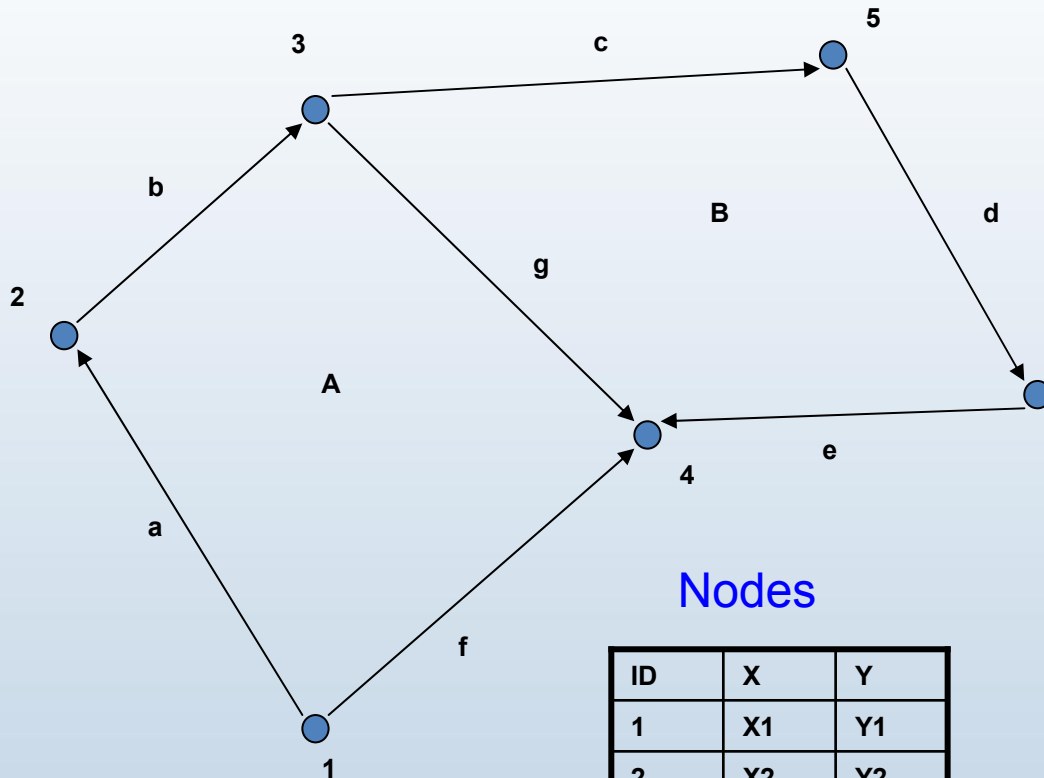
Link 2  
Parcel->LS

Registered rights  
Easement (Parcel, Utility)

# Modelling Legal Spaces



## 2D Situation



## Nodes

| ID | X  | Y  |
|----|----|----|
| 1  | X1 | Y1 |
| 2  | X2 | Y2 |
| 3  | X3 | Y3 |
| 4  | X4 | Y4 |
| 5  | X5 | Y5 |
| 6  | X6 | y6 |

## Edges

| ID | FROM | TO | LEFT | RIGHT |
|----|------|----|------|-------|
| a  | 1    | 2  | 0    | A     |
| b  | 2    | 3  | 0    | A     |
| c  | 3    | 5  | 0    | B     |
| d  | 5    | 6  | 0    | B     |
| e  | 6    | 4  | 0    | B     |
| f  | 1    | 4  | A    | 0     |
| g  | 3    | 4  | B    | A     |

## Faces

| ID | SUB | EDGE | OR |
|----|-----|------|----|
| A  | 1   | a    | 1  |
| A  | 2   | b    | 1  |
| A  | 3   | g    | 1  |
| A  | 4   | f    | -1 |
| B  | 1   | c    | 1  |
| B  | 2   | d    | 1  |
| B  | 3   | e    | 1  |
| B  | 4   | g    | -1 |

## Modelling Legal Spaces II.



### 2D

- Edges on plane divide the plane into two legal half-plane (left and right)
- Edges are determined by nodes (from and to)
- Edges delineate legal spaces

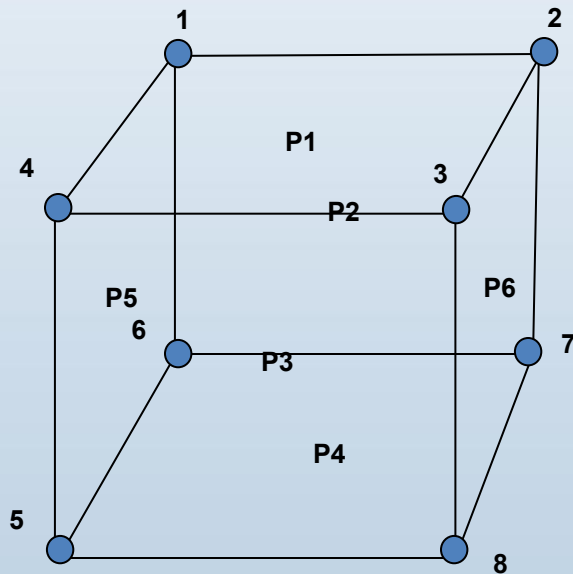
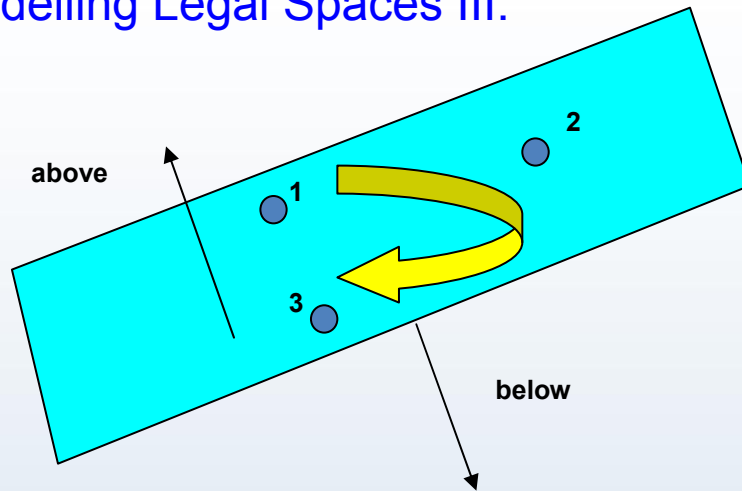
### 2D->3D

- Edges are lines
- Lines and points are exchangeable on the plane (e.g. two connected edges determine a node)
- In 3D space points and planes are the exchangeable primitives (principle of duality)

### 3D

- A Plane divides the 3D space into two half-spaces (above and below)
- Planes are determined by 3 nodes
- 3 Planes determine 1 node

## Modelling Legal Spaces III.



## Planes



| ID | FROM | MIDDLE | TO | ABOVE | BELOW |
|----|------|--------|----|-------|-------|
| P1 | 1    | 2      | 3  | A     | B     |
| P2 | 1    | 6      | 7  | A     | B     |
| P3 | 4    | 3      | 8  | A     | B     |
| P4 | 6    | 7      | 8  | B     | A     |
| P5 | 4    | 5      | 6  | A     | B     |
| P6 | 7    | 2      | 3  | B     | A     |

## Nodes

| ID | X  | Y  | Z  | W |
|----|----|----|----|---|
| 1  | X1 | Y1 | Z1 | 1 |
| 2  | X2 | Y2 | Z2 | 1 |
| 3  | X3 | Y3 | Z3 | 1 |
| 4  | X4 | Y4 | Z4 | 1 |
| 5  | X5 | Y5 | Z5 | 1 |
| 6  | X6 | Y6 | Z6 | 1 |
| 7  | X7 | Y7 | Z7 | 1 |
| 8  | X8 | Y8 | Z8 | 1 |
| 9  | X9 | Y9 | Z9 | 0 |

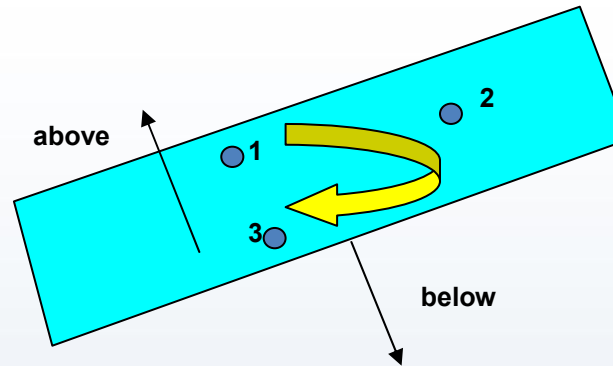
## Spaces

| ID | SUB | Plane | OR |
|----|-----|-------|----|
| B  | 1   | P1    | 1  |
| B  | 2   | P2    | 1  |
| B  | 3   | P3    | 1  |
| B  | 4   | P4    | -1 |
| B  | 5   | P5    | 1  |
| B  | 6   | P6    | -1 |

## Planes and Edges



### Coordinates of Planes



|    |    |    |   |
|----|----|----|---|
| X1 | Y1 | Z1 | 1 |
| X2 | Y2 | Z2 | 1 |
| X3 | Y3 | Z3 | 1 |

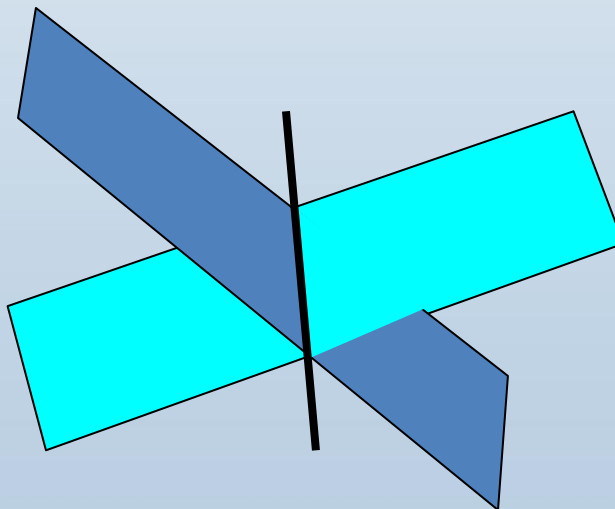
From signed sub-determinants:

$$XP = Y1(Z2-Z3) + Z1(Y3-Y2) + (Y2Z3-Z2Y3)$$

$$YP = X1(Z3-Z2) + Z1(X2-X3) + (Z2X3-X2Z3)$$

$$ZP = X1(Y2-Y3) + Y1(X3-X2) + (X2Y3-Y2X3)$$

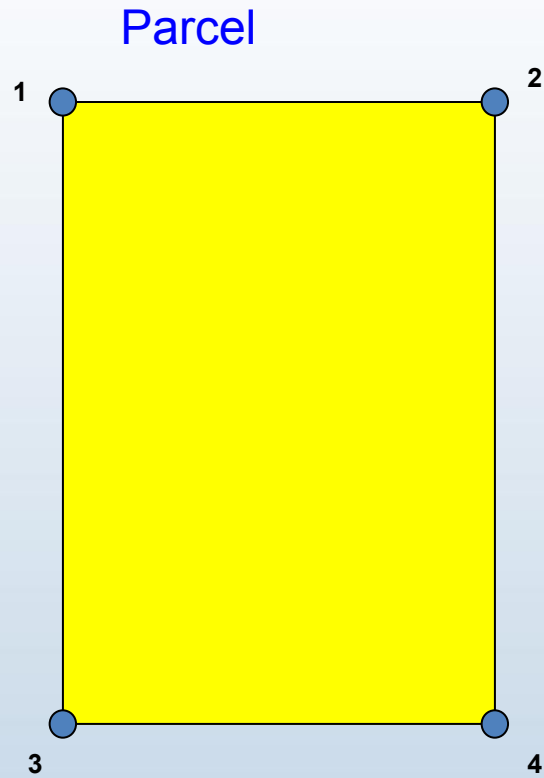
$$WP = X1(Z2Y3-Y2Z3) + Y1(X2Z3-Z2X3) + Z1(Y2X3-X2Y3)$$



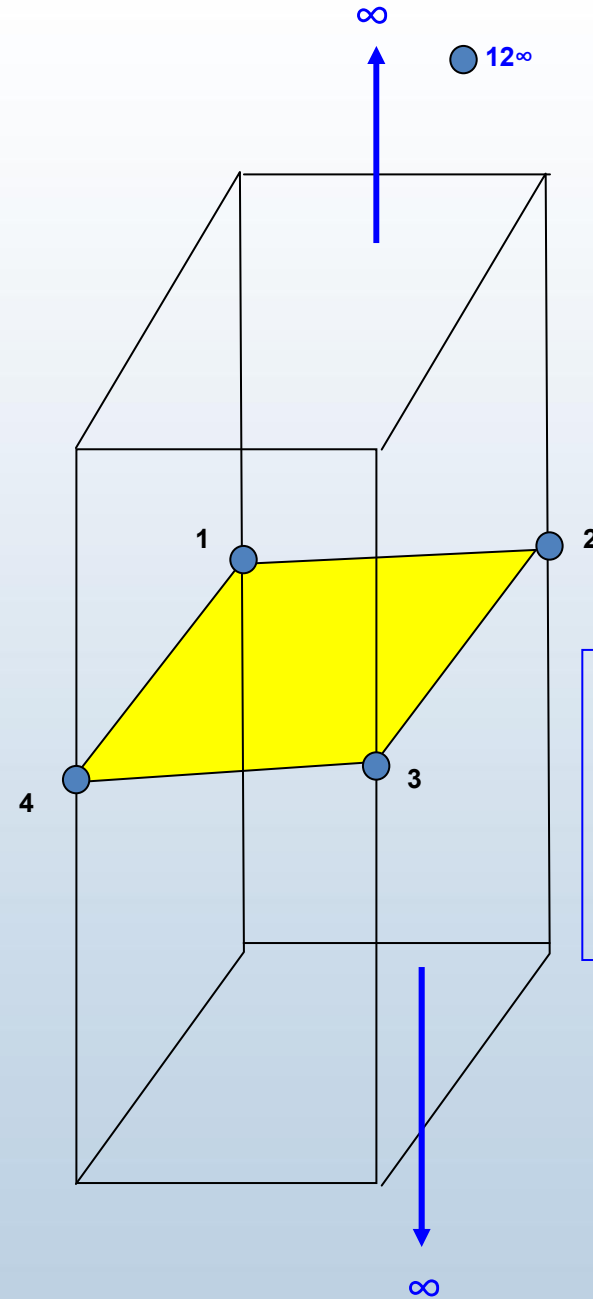
### Edges

$$\begin{vmatrix} XP1 & YP1 & ZP1 & WP1 \\ XP2 & YP2 & ZP2 & WP2 \end{vmatrix} \begin{vmatrix} XE \\ YE \\ ZE \\ WE \end{vmatrix} = \begin{vmatrix} 0 \\ 0 \end{vmatrix}$$

# Infinite Legal Spaces



$$12^\infty \begin{vmatrix} (x_1+x_2)/2 \\ (y_1+y_2)/2 \\ (z_1+z_2)/2 \\ 0 \end{vmatrix}$$

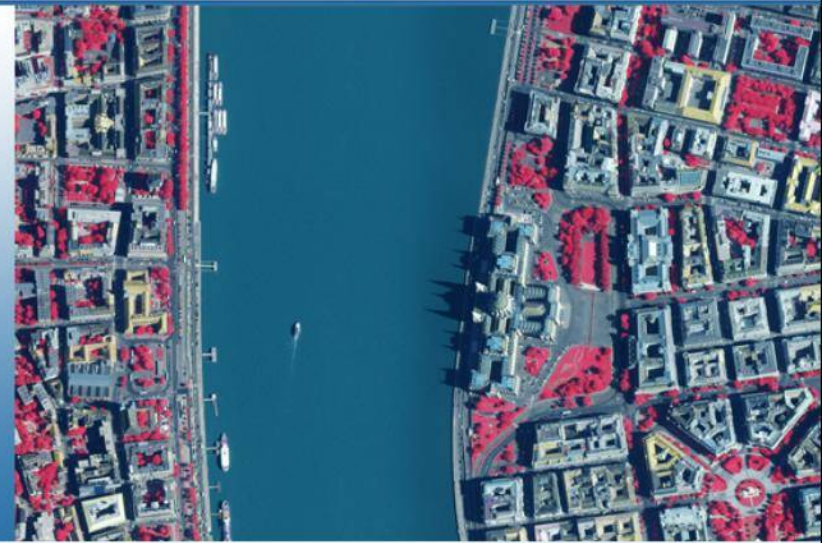


Closed by the  
plane in infinite  
Coordinates:  
(0,0,0,1)



# Conclusions

- Hungarian Land Registry is a well-prepared system for management of 3D data in Cadastre
- New legislation on Surveying and Mapping Activities and Land registry provides a good background for carrying out our ideas
- Modelling of Legal Spaces is a real challenge, our solution, we hope, leads to a simple and good result
- The full IT system of Hungarian Land Registry is under the supervision of FÖMI. Our Professional and IT efficiency should solve the challenge of 3D Cadastres



Thank you for your attention

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See you at: <http://www.fomi.hu>

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