

BIM-based Building Permit Process Automation Seminar

th February 2020 | Tallinn, Kultuurikatel, Terrace Hall

### **GeoBIM for building permits issuing**



20<sup>th</sup> February 2020

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**3D geoinformation group** *Delft University of Technology, NL* 



### **Overview**

- 1) Introduction: 3D city models and GeoBIM
- 2) The EuroSDR GeoBIM project
- 3) A new workflow for the building permits issuing using GeoBIM
- 4) Investigating **regulations and initial implementation** in the project *"GeoBIM for Building Permits in Rotterdam"*
- 5) Data models inspection: models from practice
- 6) Conclusion and final remarks

7) The European Network for Digital Building Permits



#### Intro: GeoBIM

- EuroSDR GeoBIM
- GeoBIM Workflow for building permits
- Regulations and initial implementatio n in Rotterdam
- Data models inspection
- Conclusion
- **EUNet4DBP**



Geometry

Boundary Representation

Aggregation of boundary

completely.

representation)

#### Evolution of common GIS;

In cartographic field and city management (not pushed by industry!);

Usually oriented to the representation of medium levels of detail objects (e.g. ~20 cm accuracy);



### **TUDelft** 3D GIS – 3D city models: functionalities

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### **Great advantages from integration**

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3D geoinformation: 3D city models

Building Information Models



**GeoBIM** = integration of geoinformation with BIMs

High level of detail 3D cadaster
 No tasks duplication (3D data of the second seco

No tasks duplication (3D data collection)

Efficient databases **updates** without additional costs

Effective data exchange with professionals (architects, engineers, environmental scientists, etc.)

Stronger information for **lifecycle asset** 

Context for design reference

Improved **test of building properties**: designed building into its context

> Test of the **impact of the building** on the city or landscape.

Multiscale vision (from construction elements to whole





### ...But it's not a trivial issue

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3D geoinformation: 3D city models

> Building Information Models



**GeoBIM** = integration of geoinformation with BIMs

- 1. Integration of **data** (common characteristics, they fit together)
- 2. Data interoperability
- 3. Reliable **conversions** BIM  $\leftrightarrow$  GIS
- 4. Integration of **procedures** (BIM and GIS tools)



### The EuroSDR GeoBIM project





### EuroSDR GeoBIM case studies

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### Case studies:

- The Netherlands
  (Rotterdam, Den Haag, Almere, Amsterdam)
- France (Epone)
  - Data
  - Regulations
  - Practice expertise

#### Sweden / Slovenija



**Bottom-up approach** 

They provide us with:

**Data** (IFC BIM and CityGML 3D city model)

Nice and enthusiastic **people** to collaborate with



Case study in Epone (F)

## Interviews and collaboration



- 1) Workflow + stakeholders
- 2) Regulations check
- Guidelines to designers/3D city modelers



### 1) GeoBIM Workflow proposal



#### EuroSDR GeoBIM

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- 2D Drawings [PDF 2D plans and sections]
   Designed building in City plan [PDF 2D map]
   Report proving compliance to regulations (Building physics, Fire safety, City quality,
  - structural safety, construction quality) [PDF document]



#### **Provided by the Municipality:**

Standardized *3D city model* (CityGML) *City regulations* in digital (and formal) format

#### Asked for the submission:

- A **BIM** model compliant with the given requirements (w.r.t. geometry, semantics, georeferencing) [IFC georeferenced model]

### **TUDelft** 1) GeoBIM Workflow proposal





### 1) GeoBIM Workflow proposal

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### 1) GeoBIM Workflow proposal

#### Harmonization of procedural workflows



F. Noardo, C. C. Ellul, L. Harrie, I. Overland, M. Shariat, K. Arroyo Ohori and J. Stoter, 2019. Opportunities and challenges for GeoBIM in Europe: developing a building permits use-case to raise awareness and examine technical interoperability challenges. *Journal of Spatial Science*.



### 2) Regulations most effectively checked through GeoBIM

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**Zoning and dimensions**: max height, volume, densification, distances (overhanging objects, balconies), pipe heights (restaurants).

Parking availability and plans connected to the new buildings





Impact of the building in environment and of environment on the building: shadows analysis, noise analysis, air quality, energy.

Accessibility of the buildings in higher detail: disabled accessibility and usability, and escape routes planning.

**Structural** safety in complex cases, e.g.; Amsterdam cellars; terrain deformations (bridges parts misalignments);...

### GeoBIM for Building Permits in Rotterdam

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The automation of the regulation checks is further explored. Two regulations:

- Building dimensions
- Provision of parking places

**Close collaboration with the municipality officers** usually devoted to the interpretation of such rules.

Use of **BIM**, **3D city model** data, **regulations** information to test the methodology in a **case study**.

#### Outcomes:

- a tool, allowing the automatic or semi-automatic checks of the compliancy to the selected regulations using a BIM model and a 3D city model as input.
- Guidelines and recommendations, to designers and city modelers, to produce effective models for this aim.



December 2019 – August 2020

#### **Fullelft** BDgeoinfo Rotterdam current process and regulations fields

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- 1. Spatial planning (admissibility test)
- 2. Construction
- 3. Fire prevention
- 4. Usability test
- **5. Building physics**
- 6. Architectural aspects



#### **TUDelft** 3Dgeoinfo 2) Regulations check: Maximum dimensions

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#### 5.1 Bestemmingsomschrijving

De voor 'Centrum - 3' aangewezen gronden zijn bestemd voor:

- wonen, met inachtneming van het bepaalde in artikel 5.2.4; a.
- kantoor, tot een maximum van 254.084 m<sup>2</sup> b.v.o. in Centrum b gezamenlijk;
- hotel: C.
- maatschappelijke voorzieningen; d
- bedrijven t/m categorie 2, uitsluitend op de begane grond; e
- detailhandel, uitsluitend op de begane grond, tot een maxim f. 'Centrum - 2', 'Centrum - 3' en 'Centrum - 4' gezamenlijk, me artikel 5.3.2:
- dienstverlening, uitsluitend op de begane grond; q
- horeca, uitsluitend op de begane grond; h.
- cultuur en ontspanning, uitsluitend op de begane grond; parkeergarages (boven- en/of ondergronds);

#### 5.2.3 Bebouwingsnormen

Why only centrum 2? 4.2.1 General The land intended for 'Centrum - 2' may only be built for the functions mentioned there 4.2.2 Co-destination In so far as the grounds are also intended for 'Value - Archeology 2', 'Value - Cultural History', the Aligned relevant provisions in the aforementioned destination also apply to the building. 4.2.3 Building standards The basis? Construction volume up to 200 meters high is permitted within the destination, subject to the following conditions a. as a basis, a building mass of at least 4 meters and at most 9 meters high must be realized Maximum? in the building line of the building block; b. an additional building volume may be added above the abovementioned building height of 9 meters, 22 m<sup>3</sup> per m<sup>2</sup> of building plot surface area, with a maximum of 55,000 m<sup>3</sup> per building plot, oh the understanding that land once considered in the granting of an environmental permit, which has been or can be carried out, is not taken into consideration when assessing subsequent construction plans: c. along the Wijnhaven north and south side and the Glashaven, the above under b. the aforementioned extra building volume must first be realized in a strip in the front facade line with a height of 20 to 25 meters, or in accordance with the building height existing at the time of presentation of the design for this zoning plan; - along the other streets it may be mentioned under b. said additional building volume is realized in a strip in the front façade line with a maximum height of 20 meters, or in accordance with the building height existing at the time of presentation of the design for this zoning plan; Aligned? after deduction of the volume to be realized in accordance with the provisions of c in this paragraph, the remaining extra building volume in towers can be realized on the understanding

4.2 Building rules

- the towers 15 meters behind the building lines of the Wijnhaven south side and 10 meters behind the building lines of the Wijnhaven north side are placed: the maximum permitted surface area per floor of the towers amounts to 50% of the
- ilding plat area with a maximum of EOA m? wherehe halassian

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Otherwise, what is the limit

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Francesca Noardo 1 building = 1 plot?

Francesca Noardo If land NOT considered in the granting of an environmental permit BEFOREHAND?

Francesca Noardo Extra with respect to the ones cited before (in b)? Or this is the additional building volume above the basis (the b)?

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Francesca Noardo If they are lower?

Francesca Noardo Deduction from the 55,000 m3?

- De maximum bouwhoogte is 100 meter, met dien verstande dat deze gerealiseerd mag worden met a. een onderbouw van maximaal 17 meter hoog en een opbouw van maximaal 50% van de oppervlakte van de onderbouw
- Ter plaatse van de Boompjes 60-68 en de Boompjes 55-58 is boven de 17 meter een overkraging b. toegestaan van 5 meter aan de Boompjeszijde en 10 meter aan de zijde van de Hertekade;
- Ter plaatse van de aanduiding "onderdoorgang", is een onderdoorgang verplicht. C.
- Bij een bouwhoogte van meer dan 70 meter kan ter voorkoming van gevaar of hinder voor het d luchtverkeer een omgevingsvergunning alleen worden verleend na advies van de Luchtverkeersleiding Nederland.

### 2) Regulations check: human challenges

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I Workshop 16/10/2019 – Building dimensions and parking spaces design in the city regulations





II Workshop 05/11/2019 – External experts involved in building permission issuing (Fire safety, structural safety, City aesthetics, Building physics)



### **<sup>f</sup>uDelft</sup> 2) Regulations check: human challenges**

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Conclusion EUNet4DBP **Regulation text:** "The maximum building height is 100 meters, on the understanding that it can be realized with a substructure of a maximum of 17 <mark>meters high</mark> and a construction of a maximum of 50% of the surface of the substructure. At the *location of Boompjes* 60-68 and Boompjes 55-58, an overhang of 5 meters on the Boompies side and 10 meters on the Hertekade side is permitted".













#### Intro: GeoBIM

**EuroSDR** 

GeoBIM

GeoBIM

building

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Conclusion

initial

#### **Regulation text:**

"The maximum building height is 100 meters, on the understanding that it Workflow for can be realized with a substructure of a maximum of 17 Regulatio meters high and a construction of a maximum of 50% of the surface of the implement substructure. At the location of Boompjes Rotterdam 60-68 and Boompjes 55-58, an overhang Data models of 5 meters on the Boompjes side and 10 meters on the **EUNet4DBP** Hertekade side is permitted".











### **BIM Requirements**

#### Intro: GeoBIM

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#### Premises:

- All the IFC files being part of the BIM must be in the same CRS
- **Georeferencing** information in a projected coordinate reference system must be provided in the BIM
- **Good quality semantics** have to be stored in the BIM (e.g. consistent grouping in *IfcStoreys,* separate IfcSite elements and IfcBuilding elements clearly...)





### **<sup>f</sup>uDelft</sup> 2) Regulations check: information challenges**

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#### Translation to 'formal' language and information mapping



#### **TUDelft** 3Dgeoinfo 2) Regulations check: information challenges



Building parts reciprocal relationships and dimensions: From BIM + use of typical "geo" concepts, like generalization and boundary representation

BB BP1 💻 68 BP2 ß

Calculation of overhangs towards the two streets:

From BIM + 3D city model

(which face is towards which street?)

### **<sup>5</sup>** 2) Regulations check: information challenges

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We need vertical discontinuities to find building parts







### **TUDelft** IFC models sample inspection

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## Starting point to write good guidelines





#### • NIST IFC file analyzer

- Manual inspection in **BIM Viewers** (Solibrí Model Viewer, IFCViewer, FZKViewer)
- Text format inspection

We asked for it expressely



#### **TUDelft** 3Dgeoinfo IFC models sample inspection



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#### Features affecting the potential quality of conversions

Bias factors:

+ Models involved in projects about **BIM/GeoBIM** 

- + 10 (good) Models part of **same complex**
- Infrastructure (roundabout) models, different from Building models
- Architectural / structural / installations







### **TuDelft** Conclusions Towards automatic building permits

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- **Complexity** (data issue, regulation issue, technical issue, human issue...)
- Hard work to set cross-fields collaborations and consensus but it started successfully
- **Specific steps** to fill the workflow boxes
- The bottom-up approach, starting very specifically from one regulation in one parcel in Rotterdam allowed to enlighten the concrete problems which are at the base of any regulation check with the involved digital data (how to extract limits, surfaces, references, directions).







*"European"* since we agreed that for the moment we are mainly focussed on Europe and we are strongly related to European state of art. Although this, we are open to any other **Countries** to collaborate with us and be involved.









### Objectives

Following the **common interests** in the development of a methodology (including guidelines, best practices, tools, and so on) to support the **digitization and the automation of the building permit issuing process**, the network was born, aiming at the definition of a common **strategy** and the organization of an **international network** working of the same purpose:

- Definition of a **roadmap**
- Development of digital building permits tools and methods in a common effort, with advantages to interoperability, procedures and data optimization, standardization and good implementations.



First meeting was held in Amsterdam (NL) on 17<sup>th</sup> January 2020: get to know, share previous experiences and interests



We began to coordinate

We have a website (under construction)

https://3d.bk.tudelft.nl/projects/eunet\_bp/



### Next steps

Fill the website and follow the coordination in more specific project(s)



- Kick-off in Brescia (Italy) May 2020:
- State of the art
- Limits and advantages with people involved in already working systems (both municipalities and designers).
- Needs and requirements from the point of view of stakeholders and designers about how to develop an effective methodology.

### Workshop event in Delft (NL) - 2021

[check the website and subscribe to the newsletter to stay informed]

Interdisciplinary framework needed: Programmers Government Application Research (practice) 3D City  $\checkmark$  $\checkmark$  $\checkmark$  $\checkmark$ Models BIM  $\checkmark$  $\checkmark$  $\checkmark$  $\checkmark$ GeoBIM  $\checkmark$  $\checkmark$  $\checkmark$  $\checkmark$  $\checkmark$  $\checkmark$  $\checkmark$  $\checkmark$ . . . AEC  $\checkmark$  $\checkmark$  $\checkmark$  $\checkmark$ planning  $\checkmark$  $\checkmark$  $\checkmark$ and

regulations



# Thank you for your attention <sup>(2)</sup>



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#### **3D geoinformation group** *Delft*

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### European network for Digital Building Permits

