

# **WEB 3D VISUALIZATION OF NOISE MAPPING FOR EXTENDED INSPIRE BUILDINGS MODEL**

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# CONTENT

## **Legal and standardization framework**

- European Noise Directive
- INSPIRE Data Specifications

## **Technological framework**

- CityGML
- X3D

## **Use case**

## **Conclusion and future work**

# EUROPEAN NOISE DIRECTIVE (END)

**Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002**

**END defines the methodology for noise mapping**

- noise indicators  $L_{den}$  (day-evening-night equivalent level) and  $L_{night}$  (night equivalent level).
- noise map for a level of 4 meters above the terrain

**Directive starts the development of long-term EU strategy**

**Together with INSPIRE Directive, Directive on public access to environmental information and Aarhus convention have established two distinct aspects with regard to informing the public:**

- the availability of noise information upon request
- the active and systematic dissemination of noise information to the public

# INSPIRE – BUILDINGS

**This application schema focuses on the physical description of real world entities seen as constructions**

**Buildings spatial data theme defines four profiles:**

- Buildings2D – 2D (or 2,5D) geometry, basic semantics
- Buildings3D – 3D geometry, basic semantics
- BuildingsExtended2D – 2D geometry, extended semantics
- BuildingsExtended3D – 3D geometry, extended semantics

**All profiles are inspired by CityGML**

- 2D profiles – only semantics
- 3D profiles – geometry and semantics

# CITYGML (*CITY GEOGRAPHY MARKUP LANGUAGE*)

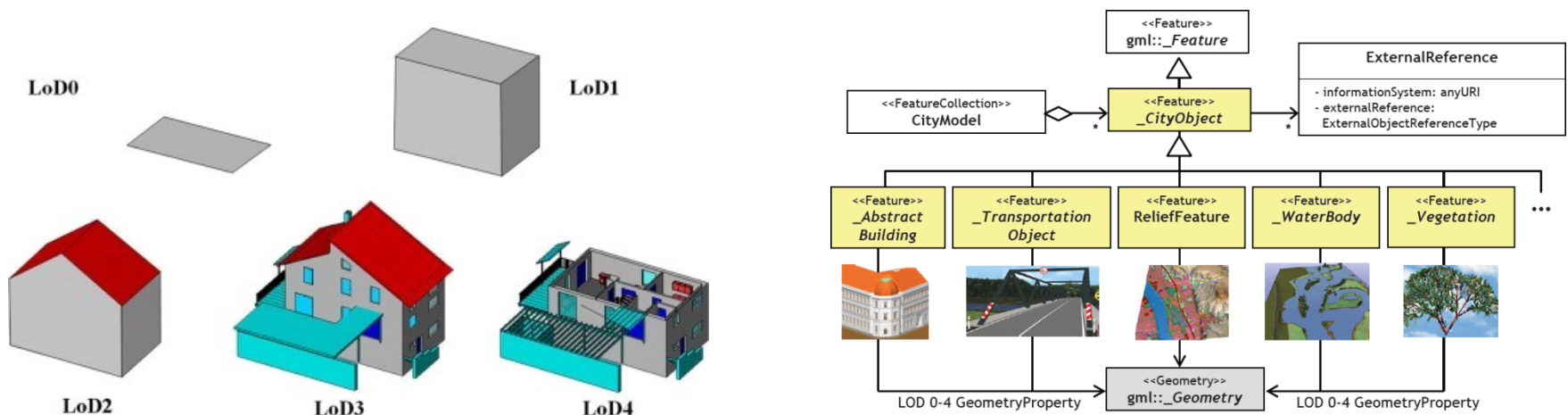
Open data model and XML based format is designated for description of 3D urban objects

CityGML includes information about 3D geometry, semantics, appearance and topology

CityGML use *Level of Detail* (LOD) concept

Semantics contains classes for DTM, buildings, water bodies, transportation objects, vegetation or city furniture

CityGML is standardized by OGC (*Open Geospatial Consortium*)



# **X3D (EXTENSIBLE 3D)**

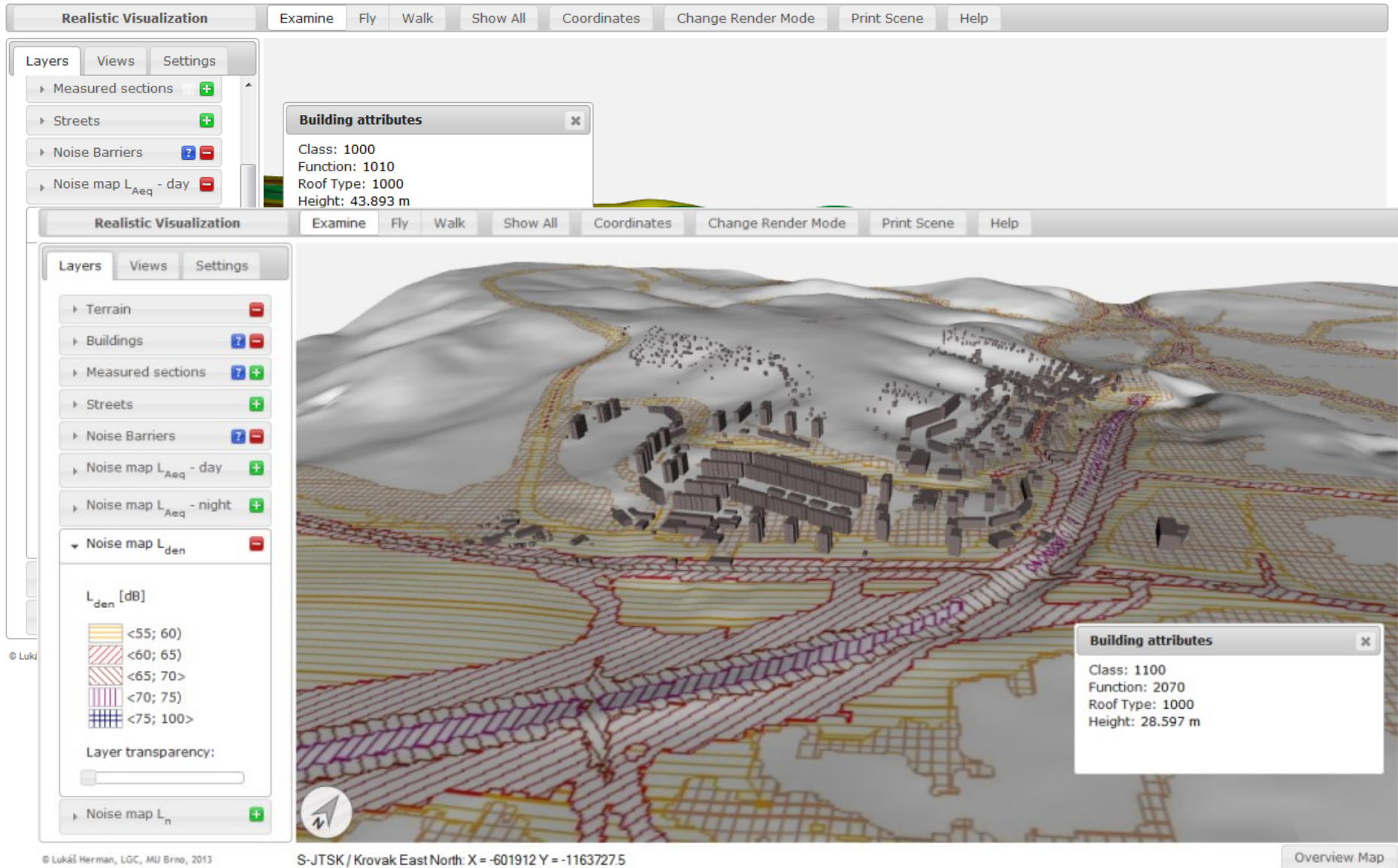
**X3D is XML-based 3D graphics format**

**X3D is standardized by ISO (*International Organization for Standardization*)**

**X3D supports 3D and 2D graphics, animations, audio, networking or user interaction**

**X3D structure can be embedded directly in HTML code and rendered by JavaScript (X3DOM library – [www.x3dom.org](http://www.x3dom.org))**

# USE CASE



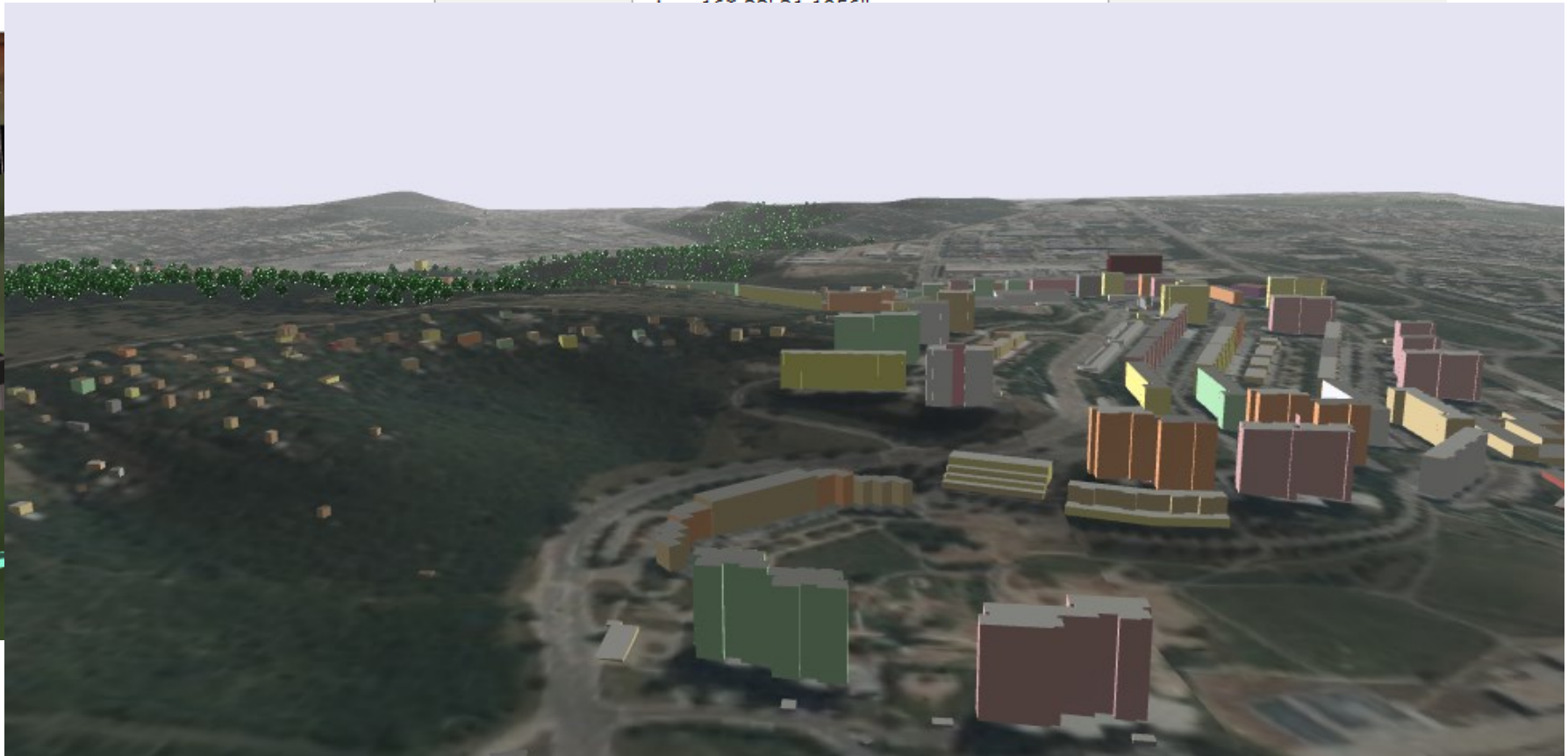
# USE CASE

## Building attributes

Class: 1000  
Function: 1010  
Roof Type: 1000  
Height: 38.512 m

## Coordinates

X = -602105.97 m  
Y = -1161875.09 m  
h = 357.78 m  
B = 49° 10' 52.5125"





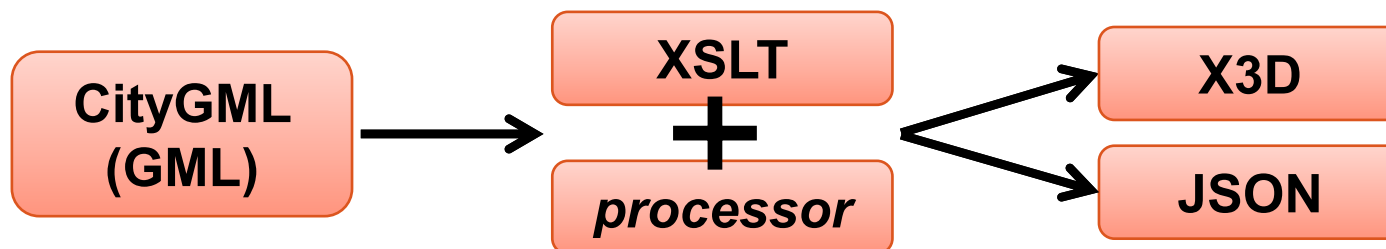
# DATA TRANSFORMATION

**Source:** CityGML file

**Other possible sources:** GML file according to INPIRE Buildings application schema or *Web Feature Service* – WFS

All described formats are **XML based** → they are transformed by *eXtensible Stylesheet Language Transformation* (**XSLT**)

Geometry is stored as **X3D** and attributes as **JSON** object, they are linked by unified identifiers (attributes) and JavaScript



# **ADVANTAGES OF PROPOSED SOLUTION**

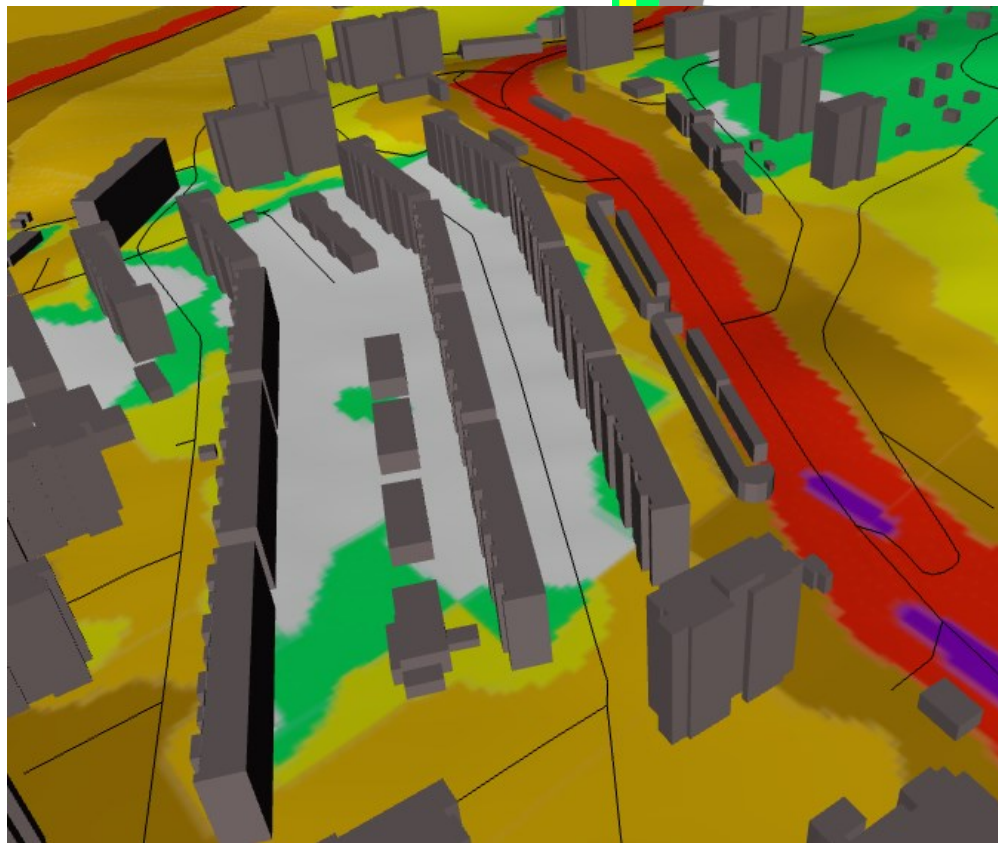
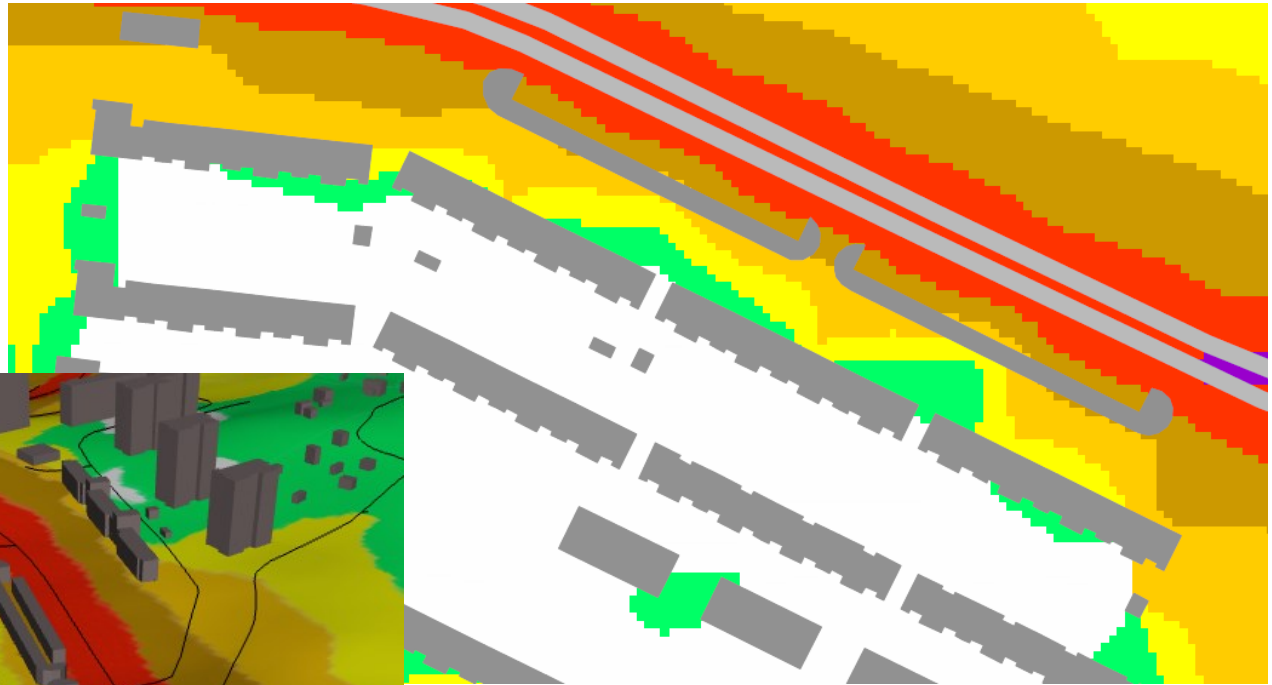
**X3D enables user-friendly 3D visualization based on standardized Web technologies**

**X3D does not require to install any new software or plug-in**









**X3D enables to present noise maps calculated in 2D as 3D visualization**

**X3D enables exploration of barrier effect caused by high buildings blocks and/or other impacts of terrain and buildings**

## 2D NOISE MAP VERSUS 3D



$L_{Aeq}$  [dB]

	(0; 40>
	(40; 45>
	(45; 50>
	(50; 55>
	(55; 60>
	(60; 65>
	(65; 70>
	(70; ∞)

# **OPEN ISSUES AND FUTURE WORK**

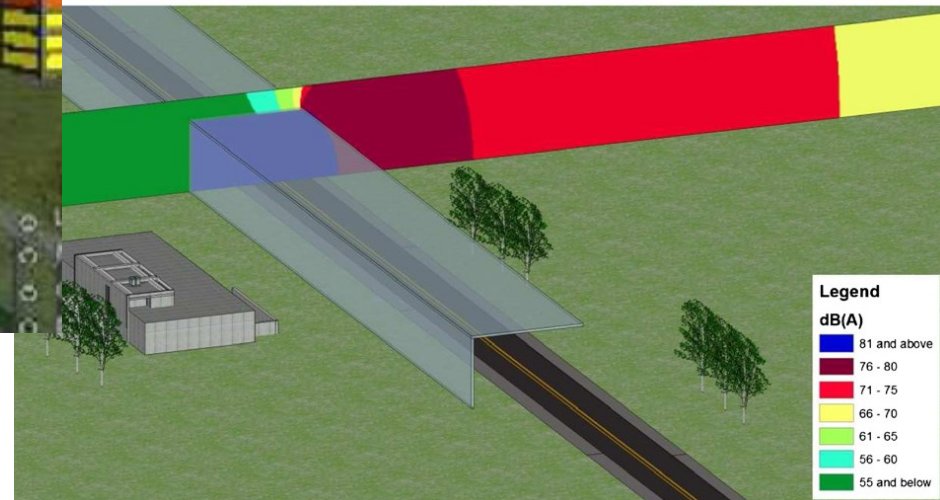
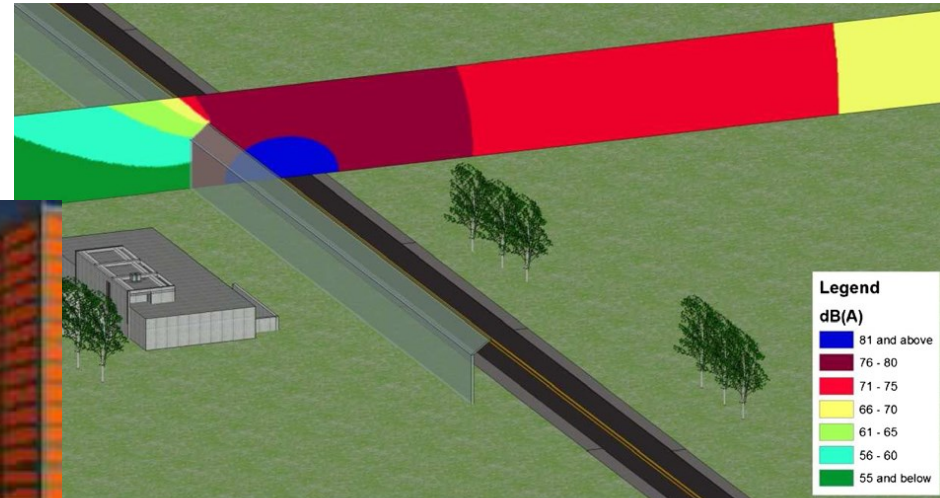
**Weakness of INSPIRE Buildings spatial theme lies in the lack of visualization rules**

**Visualization rules are formalized through the OGC Styled Layer Descriptor (SLD) in the INSPIRE technical guidelines; however any rule does not relate to a 3D profiles**

**Currently the END requires only the noise map for a level of 4 meters above the terrain, but 3D visualization allows displaying a noise value at each part of a building.**

**3D technique would be valuable for visualization of areas highly polluted by noise → „real“ 3D noise maps**

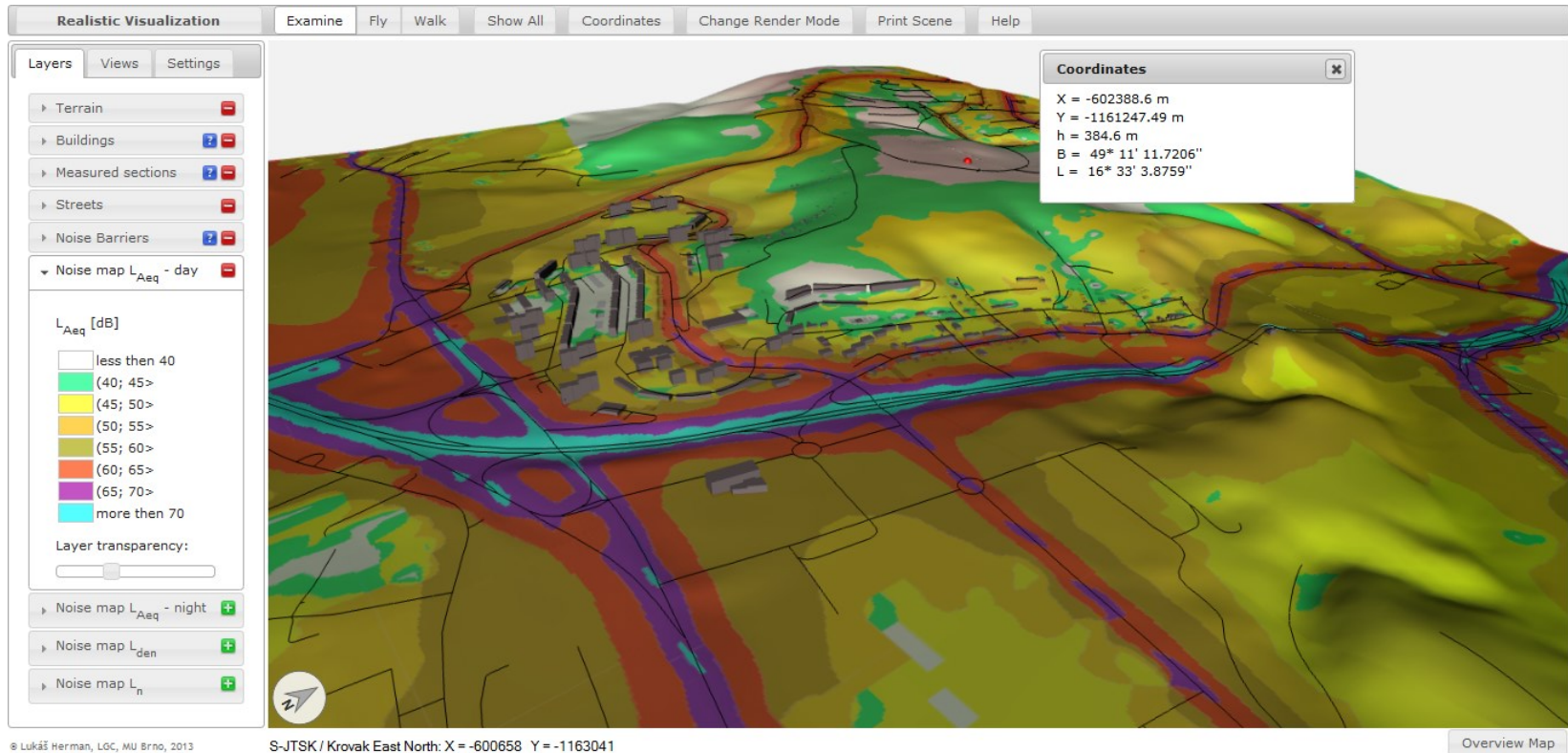
# „REAL“ 3D NOISE VISUALIZATION



Law, C., Lee, C., Lui, A. S., Yeung, M. K.,  
Lam, K.: Advancement of three-dimensional  
noise mapping in Hong Kong. Applied  
Acoustics 72(8), 534-543 (2011)



# THANK YOU FOR YOUR ATTENTION



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