



# 3D REGISTRATION OF CONDOMINIUM RIGHTS THROUGH BIM MODELS

2D DATA IS INSUFFICIENT FOR THE COMPLETE REGISTRATION OF PROPERTY RIGHTS FOR CONDOMINIUMS IN TODAY'S MULTI-STOREY, COMPLEX BUILDINGS. **DOGUS GULER** EXPLAINS HOW LADM AND IFC STANDARDS CAN BE USED TO MODEL CONDOMINIUM RIGHTS IN 3D

The sustainable development of smart cities has become crucial due to climate change and excessive urbanisation that substantially force governments to practise complex strategies. These strategies to improve infrastructure facilities, city services and environmental quality aim to secure wealth, habitability and healthiness for citizens.

In this connection, effective land management is vital for the sustainability of the built environment. In relation to this, solid Land Administration Systems (LAS) are needed in order to put into practice effective land management. These systems deal with recording the information on rights,

responsibilities and restrictions (RRR) in a cadastral database as components of property rights that may occur both underground and aboveground. Rapid migration and the resulting rapid population growth mean a large number of buildings are being built in urban areas. This transformation has led to the construction of multi-storey buildings. But developing technologies mean the complexities of these multi-storey buildings are increasing day by day.

A type of property right registered under the LAS are the condominium rights that can occur in buildings. Condominium rights, which can be formed in the independent

sections of the buildings that are suitable for use on their own, are currently one of the most important property rights registered. Although LAS are widely implemented based on the use of 2D data around the world, they deal with the registration of rights that naturally have a third dimension, as defined in laws and regulations. However, the legal, social, economic and environmental developments experienced in the past few years reveal that LAS in their present form might be insufficient to cope with the problems that may arise.

At this point, it is the dominant view in the international literature that LAS need

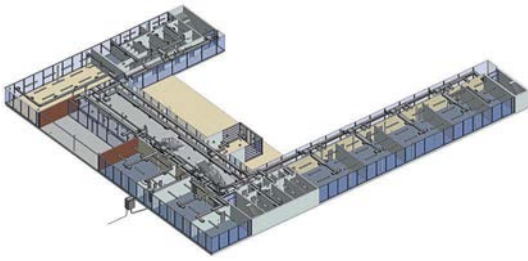


Figure 1. Sample view from BIM model of a complex building

to be developed such that they have the capacity to process and manage 3D data in the registration of property rights. In other words, 2D data is insufficient for the complete registration of the property rights subject to condominiums in today's multi-storey, complex buildings.

**2D is not enough**

2D representations and information notes cannot fully reflect the real situation regarding vertical property rights in the registration of all condominium units, common areas and all kinds of annexes with details. For this reason, there is a need for a 3D, IT-supported representation of the vertical property rights that are subject to condominium ownership.

Today, there is increasing adoption of Building Information Modelling (BIM) technology, which replaces CAD, especially in architecture, engineering and construction (see Figure 1). By means of BIM, building models can be obtained in 3D in detail by using an object-based modelling approach. Further, the interoperability of the obtained BIM models between different stakeholders and applications is ensured by the open data standard Industry Foundation Classes (IFC), which is also an ISO standard. For an effective land administration practice, the ISO standard Land Administration Domain Model (LADM) provides a conceptual model that includes activities related to land administration, stakeholders, spatial objects and relations between them in order to create a common basis.

The main purpose of my doctoral research was to integrate the LADM and IFC standards to model condominium rights in 3D. First, I examined 3D condominium applications around the world and analysed the current situation. I then developed an integrated

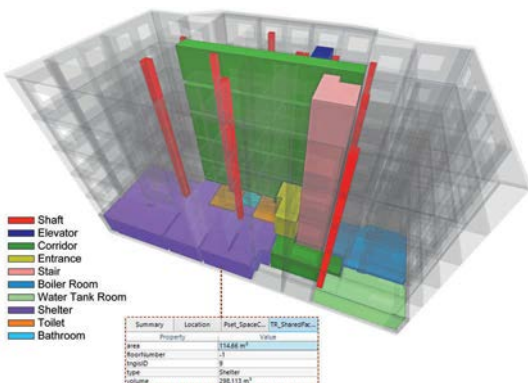


Figure 2. The shared/common spaces in the building

model with appropriate relationships between the features in the LADM standard and the entities in the IFC schema.

To test the applicability of the model I developed, I created a BIM model of a sample building and obtained the final IFC model by enriching the content of the building model (see Figure 2). I was able to demonstrate that it is possible to model RRR in the context of cadastral registration for various building elements as well as legal spaces subject to condominium rights. It is also possible to unambiguously represent condominium property rights and register them in a land registry by using as-built BIM models.

**THE INTERPLAY BETWEEN BIM- AND GIS-BASED MODELS IS INEVITABLE**

In addition to the 3D registration of vertical property rights to buildings, another issue to consider is the digitisation of public services. At the start of construction, there is a need to digitise and automate the building permit processes to improve the compliance checking of construction projects by considering environmental factors. Moreover, 3D digital city models are needed to provide a scientific basis for the decisions taken on the built environment, but these models are difficult to keep up to date because of the rapid changes in cities. Therefore, the interplay between BIM- and GIS-based models is inevitable.

The common point of these issues is 3D digital building models. In this context, a tripartite (3P) cycle vision has proved relevant. This includes digital building permit procedures, 3D city model updating and 3D registration of property ownership (see Figure 3).

**Conclusion**

BIM models offer an important option for 3D modelling of the legal spaces regarding the condominium rights that can be composed in buildings. Although the IFC schema does not contain special entities and properties regarding the condominium rights, 3D digital models for registering condominium rights can be obtained by expanding the existing entities with new property sets and properties.

Enriched IFC models can be used in 3D LAS transformation because they provide 3D spatial information and semantics with respect to condominiums and related property counterparts such as annexes. BIM/IFC models provide an important basis for the determination of the nominal values of the factors within the scope of 3D property valuation, which is increasingly used in determining land shares.

- Conflict resolution can be achieved more easily with both 3D visualisation and a rich semantic basis provided by BIM/IFC models in cases of common areas where problems may arise due to uncertainties regarding condominium rights.
- Valuations of condominiums can be determined more realistically and scientifically by using comprehensive BIM/IFC models. The problems associated with declaring the value of real estate can then be minimised.
- BIM/IFC models can also be used in energy analysis and in the dissemination of green energy and renewable energy in the context of sustainable development.
- In real estate purchase and sale transactions, accurate information about condominiums and the annexes they have the right to use can be provided with the help of BIM/IFC models.
- BIM/IFC models used in the registration of condominium rights provide an important data source that will enable 3D spatial analyses in the context of 3D LAS.
- Since BIM/IFC models of newly built buildings will be obtained, these models can be used for different smart city applications such as the internet of things.
- BIM/IFC models used in the registration of condominium rights can be converted to different spatial data standards such as IndoorGML and a database can be provided for different applications such as indoor navigation.

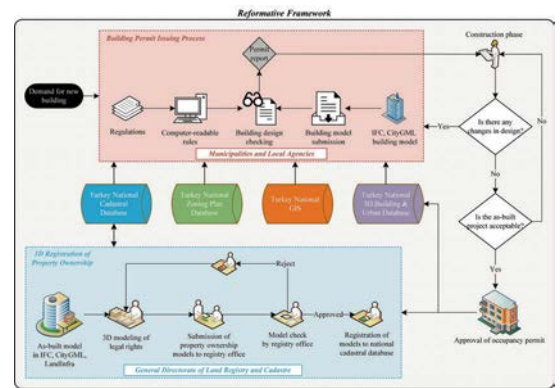


Figure 3. The framework relating to digital building permit procedures, generating the 3D urban models, and 3D registration of property ownership

Due to the difficulties that may arise from the ambiguity of the wording in the legal documents, it requires a special effort to convert the legislative rules on building permitting into the computer-readable format.

Considering that digital building permitting is based on the use of BIM in general and IFC models in particular, it is necessary to ensure that BIM technology is effectively adapted to the industries involved in the process.

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