Unique Identifier for 3D Cadastre Objects Registration

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Key words: 3D Cadastre, 3D Registration, Unique Feature Identifier

SUMMARY

In Malaysia, cadastre system is carried out in two-dimensions (2D) and all cadastre have their own unique ID, called Unique Parcel Identifier (UPI). UPI is widely used in various land transaction purposes e.g. sale and purchase of land, land development, and so forth. Traditionally, cadastral registration system is a basic 2D land system. In the near future, 2D cadastre faces some difficulties in answering queries related to 3D complex situations such as apartments, towers, condominium, and etc, thus 3D cadastre seems most appropriate to be developed. This paper discusses the concept of determining the unique identifier code for each 3D object called Unique Features Identifier (UFI). This paper discusses the recognition of 3D objects cadastre based on the existing UPI concept and method. This paper will highlight the complex 3D situation in Kuala Lumpur underground tunnel, a.k.a. 'SMART' tunnel (**S**tormwater **Ma**nagement and **R**oad **T**unnel) in relation to the cadastre unique identifier. We will also highlight some future works of the identifier for 3D cadastre objects.

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1. INTRODUCTION

A Cadastre is normally a parcel based, and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests i.e. the ownership the value of the parcel, taxes of the parcel and etc. 2D cadastre has been used for centuries in Malaysia and it could provide vital information about land and property such as land title. The management of the cadastral system is under responsibility the National Mapping Agency (NMA) which is the Department of Survey and Mapping (JUPEM) and Land Office (LO) which is Land and Mineral Office (PTG). These two different organization have their own separated database contain the information on cadastral in Malaysia. The separated system being related by using common unique identification called Unique Parcel Identifier (UPI) and only with this UPI the information of the cadastral lot and the ownership can be derived together. The information contain in this so called 2D cadastral system are the information about lots and property owners, such as lot number, ID geometry and dimensions of the parcel and others. The updated cadastral information is useful to consumers to meet their needs. However in very near future this 2D information may not be able to serve for more advanced situations for example in large city centers because one way to deal with this situation is by having a more advanced cadastral system like 3D cadastre. This shows the needs to extend the 2D system into a three-dimensional (3D).

UPI is a unique way of identification of land parcels and it being used among the government and private agencies such the local authorities, taxes department and etc. The purpose of creating the UPI is to identify the structural form and physical characteristics of each parcel of land (lots). Each parcel set a consistent code structure. This can help the sharing of information about the land and to help each user who dealing with the matters. Nowadays, people are trying to use the limited spaces optimally and rapid development in urban areas and especially the business centre has led to multilevel building constructions. Although the properties was located on top of each other for years, only recently that these questions have been raised as to whether cadastral registration should be extended into the third dimension (Stoter, 2004). Thus, there is necessity to find solutions suitable for the construction of the cadastral layer. Therefore, the proposed 3D cadastral system must be able to represent the real world and not parcel of land surface. Traditional cadastral systems and land based 2D registration is not ready to apply the land registration in 3D. As far as Malaysian cadastral has been concerned, few researches have been done, however, this paper will discuss and extend the idea of having 3D Cadastre for Malaysia into the unique identification for the 3D cadastral objects. For next section, the paper will discuss about the Unique Parcel Identifier (UPI). In section 3, it will mention about the Strata Title in Malaysia current practice, while 3D cadastre and some of the information that related to 3D cadastre will be discuss in Section 4. In section 5, this paper will be mention about the Unique Features Identifier (UFI) and the overall results

of the study. Further in Section 6, some of the issues on handling complex cadastral situation will be highlighted and conclusion in Section 7.

2. UNIQUE PARCEL IDENTIFICATION (UPI)

In Malaysian cadastre system, spatial and textual inform ation about the land parcel acquired from two different sources which are from Digital Cadastral DataBase (DCDB) in JUPEM and the Computerised Land Registration System (CLRS) in PTG is not uniform. This resulted in the information of land parcel acquired by online users is difficult to access and analyze because the data is using a different code and name of the land administrative boundaries. Unique Parcel Identifier (UPI) coordination started early in 1997 is a method of identifying the physical land parcel (lot) locations based on unique code. It aims to assist in retrieval and exchange of spatial (from DCDB) and non spatial (from CLRS) cadastral data. Provide a basis for implementing a uniform documentation of the relevant agencies and facilitate the efforts of system integration and interoperability.

This coordination will be beneficial in solving the problems that arise in geospatial information on matters of land transactions involving the various agencies.

Unique Parcel Identifier (UPI) is very important for all matters related to land or strata. UPI widely used by many government and private agencies because it involves the sale and purchase of land, land development, and so forth. Code for each UPI is determined by the JUPEM, and it is very important to be adjusted for consistency of use by relevant agencies. In addition, the use of UPI also helps government agencies in the development of application systems and provides a basis for implementing a uniform documentation by varies agencies. Malaysia Geoportal is one of the applications that use UPI for the data cadastre finding of the land parcel for the whole Malaysia including Sabah and Sarawak. Table 1 shows some of the example of UPI code according to State, District, Town / City, Sections and Lot No.

Table 1. Example of UPI code

No	State	District	Town/City	Section	Lot No.	UPI
1	Johor	Batu Pahat	Bagan	-		
	01	01	01	000	0001234	0101010000001234
2	Kedah	Langkawi	Bohor	-		
	02	04	02	000	0001234	0204020000001234
3	Pahang	Temerloh	Mentakab	-		
	06	08	40	000	0001234	0608400000001234

From the example in the table above, it shows that there will be duplication on the lot number (Lot No.) but with the other code on the State, District, and Town/City with 16 characters will make the UPI is unique throughout the whole country of Malaysia.

3. STRATA TITLE

JUPEM is using a paper form of strata title to see every corner of the area and height. Each strata plan display a lot number, the scheme, building codes, level floor and the number of individual plots, the height of the individual parcels, parcel characteristics, and serial number of the plan. It is inconvenience to users where they need to check information of each strata plan (consisting of floor plan in Figure 1) before any measures can be taken. If the plans are not structured, they require a longer time to adjust them according to the serial number on the plan. Strata Title subdivision is an appearance of multi-storey building on the parcels in a strata lot. This subdivision means the production of separate title called strata title for each parcel (unit) in a building that has two or more stories. Titles are issued for each unit (plot) of a building that has two or more levels of alienated land held as one lot where the approval for the subdivision of the building has been approved. Strata development is starting from the planning stage in which matters relating to land matters will be resolved.

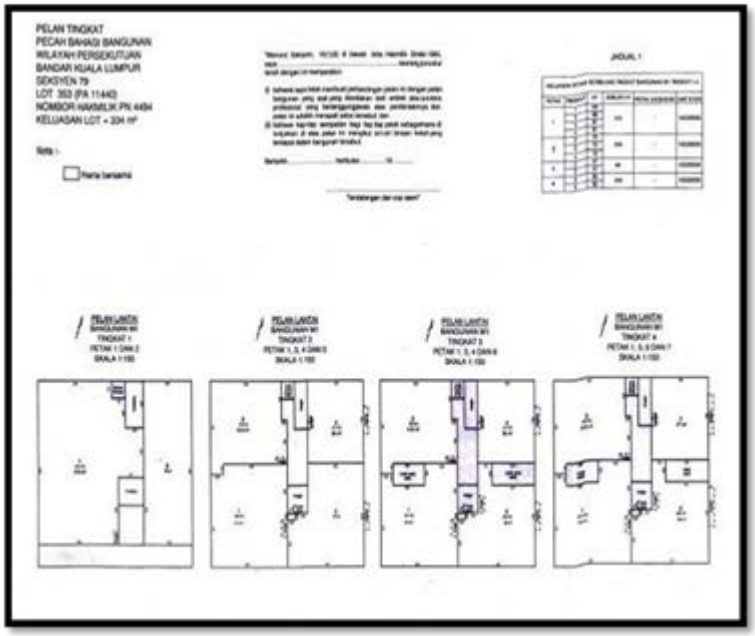

Figure 1. Example of Floor Plan

Information on the strata is under responsibility of the Land and Mines Office (PTG) and Department of Survey and Mapping Malaysia (JUPEM) in which title information is stored by the PTG and the cadastral information (strata) are stored by JUPEM. Each department has their own systems for management purposes. Computerized Land Registration System (CLRS) is controlled by the PTG and the Cadastre Data Management System (CDMS) is operated by the JUPEM. Both these systems are still run by the two-dimensional (2D) (Hassan, M.I. et. al., 2006). However, factors that promote the 3D cadastral registration is the increase in property values, construction of tunnels, utility facilities (cables and pipelines), an underground car parks, shopping complexes and many high rise buildings and the development of the 3D approach in other areas such as 3D GIS, data 3D topography, 3D data collection (GPS, laser, surveying the field), leading to a 3D approach in the cadastral registration should be done and manageable (Stoter, 2004).

4. 3D CADASTRE

In Malaysia, development of 3D cadastre registration is the technical part where researchers study the process of adding 3D objects in the cadastre data model at this time and the information that can be achieved between DSMM and LO, unfortunately, two national databases of DCDB and CLRS work separately within two different organization and is still in the 2D situation. As noted in previous studies, Malaysia land administration based on the Torrens system. However, because of historical problems, it seems quite difficult to recognize this except with the full cooperation of the various regulatory agencies, technical institutions, organizations and other land-related government and private sector as well. In recent years, the proposed cadastral registration of 3D model is focused on a combination of two different databases mentioned above and these two cadastral registration database that is an attribute of land rights legislation and the object of geo-spatial data. DSMM and LO mentioned above is the main government agency responsible for cadastral registration system in which they will integrate and coordinate with each other, to have the system fully integrated 3D cadastre in Malaysia (see Figure 2) preserving current 2D cadastral system with 3D Cadastre hybrid approach adapted from Core Cadastre Domain Model by FIG to suite with Malaysian local cadastre system (Hassan, M. I. (2010).

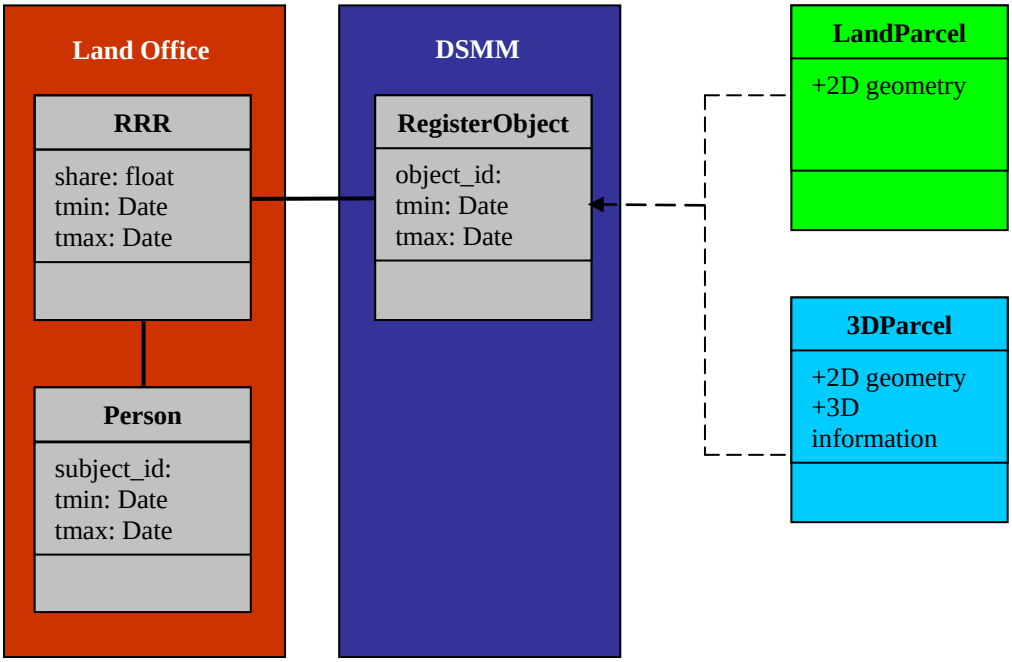

Figure 2. Adaptation of CCDM into Integrated 3D Cadastre Model for Malaysia where LandParcel and 3DParcel is part of RegisterObject

Cadastre should be able to provide sufficient and clear about the property, the boundaries in all dimensions, even for complex situations such as high rise properties as a strata title. The proper way of 3D registration should be clearly identified before this 3D Cadastre can be fully implemented. UPI is the code to identify 2D land parcel, some other unique feature identifier are needed to handle 3D cadastre objects such as strata title.

5. UNIQUE FEATURE IDENTIFIER (UFI)

Unique Feature Identifier (UFI) is needed to solve problems in 3D cadastre management in Malaysia. The UFI in this paper will adapt from the current practice of Malaysia cadastre on handling the strata object registration. Three study cases involving different types of buildings have been identified in order to show the implementation of the proposed UFI. The UFI code structured from UPI plus 10 other characters as the additional code for the 3D cadastral objects. The UPI code where consist the code of the State, District, Town/City, Section, and Lot Number will be extended to Building (3 characters), Floor (3 characters), and Plot (4 characters). The UFI consist 26 characters code and it will make the particular 3D cadastre object have a unique identification throughout the country. The example of the UFI can be seen clearly in Table 2 below.

Table 2. Example of UFI Code

State	District	Town/City	Section	Lot No.	Building	Floor	Plot
06	08	40	000	0001234	M01	001	0007
UFI	**06084000000001234M010010007**						

From the example given above, it shows that the particular 3D cadastral object is located at the state of Pahang, in the district of Temerloh (06), city of Mentakap (08), without any section (000), in the lot number 0001234, building number 01, on floor 001 with the 0007 as the plot number. For further explanation, three cases have been identified which are the Apartment, the Town House and the Hanging Properties.

5.1 Apartment

For a case study of Apartment buildings, fixing UFI for each parcel of strata is difficult because the building is located on one lot. Identification or the ID for strata title in current cadastre system practiced is to set the ID of the apartment building with the letter ‘M’. The building constructed with almost the same structure as apartments such as condominiums, flats, and etc., also using introductory letter 'M'. For example, in one lot with three buildings, thus, the buildings known as M01, M02 and M03. ‘Floor’ is referring to level of the building. Code for the level of the building is in the form of numbers and each level is numbered according to the lowest level that is above ground. Meanwhile, the level of the building below ground level will be delegated the letter 'B' and numbered '01 'starts from the top level of the ground surface, for example,' B01 ' referring to the first floor below the ground level. ‘Plot’ is referred to the strata lot which all the strata lots will be numbered from the lowest part of the building including the underground level. The table 3 shows the structure of the apartment building UFI code.

Table 3. Code Case UFI for Apartment Buildings

State	District	Town/City	Section	Lot No.	Building	Floor	Plot
03	02	01	001	0001234	M01	001	0007
UFI	**03020100100001234M010010007**						

3D model for this building type had been built by using the SkecthUp 8.0 which is the structure of the Apartment has been created according to actual concept of the building. Figure 3 shows the 3D Building of apartment that created by using Sketchup 8.0. Then, the 3D building from this software exported to ArcGIS 10 to develop a simple database and attribute table for the UFI code. Figure 4 shows the 3D building for apartment by using ArcGIS 10 and simple query for the UFI and strata parcel of the building.

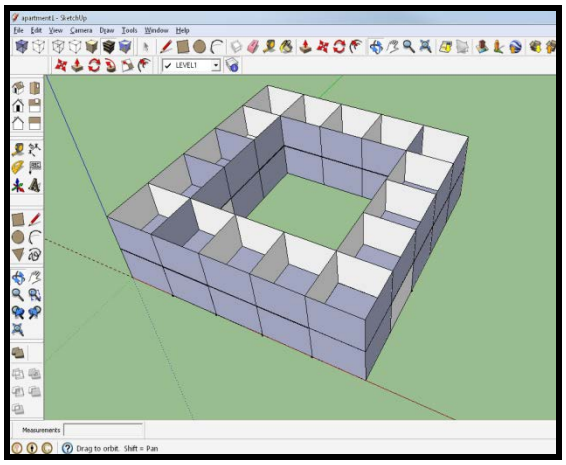

Figure 3. 3D Building of Apartment by using SketchUp 8.0

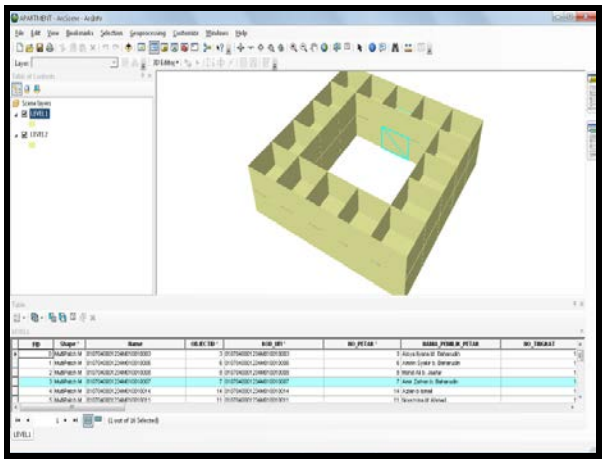

Figure 4. 3D Building of Apartment by using ArcGIS 10

5.2 Town House

A case study for the Town House building that not involves many of plot strata because the concept of this building has only three or four owners on the same lot. In contrast to the apartment building where the Town House does not share the entrance of the parcel or do not have lots of accessories in the land. For this building type, it uses the letter 'T' to represent the types of buildings. Code for the level of the building was set using the order numbers in sequence starting from the lowest level including the basement. For this type of building, the Table 4 shows the structure of the UFI code for Town House building type.

Table 4. Code for building UFI Town House

State	District	Town/City	Section	Lot No	Building	Floor	Plot
03	02	01	001	0001234	T01	002	0021
UFI	**03020100100012 34T010020021**						

3D model for this building type had been built by using the SkecthUp 8.0 which is the structure of the Townhouse has been created according to actual concept of the building. Figure 5 shows the 3D Building of Townhouse that created by using Sketchup 8.0. Then, the 3D building from this software exported to ArcGIS 10 to develop a simple database and attribute table for the UFI code. Figure 6 shows the 3D building for Townhouse by using ArcGIS 10 and simple query for the UFI and strata parcel of the building.

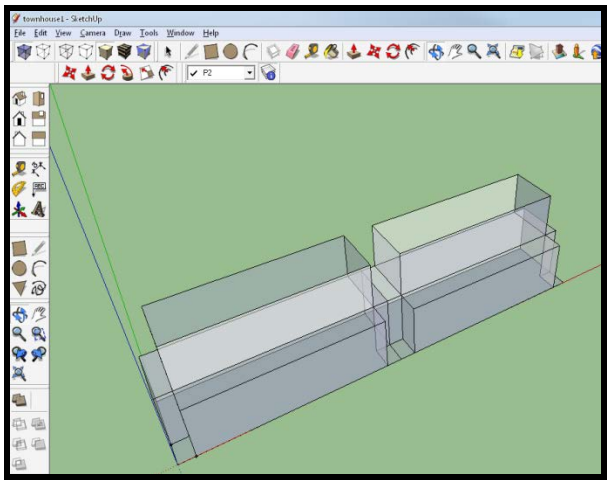

Figure 5. 3D Building of Town House by using SketchUp 8.0

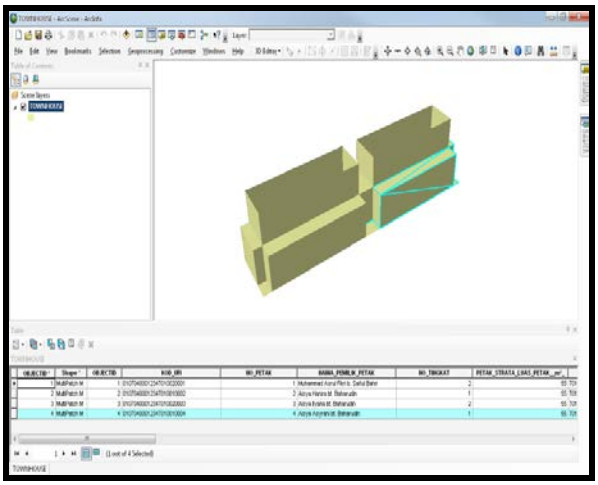

Figure 6. 3D Building of Town House by using ArcGIS 10

5.3 Hanging Properties

'Hanging Properties' building is two buildings located on two different lots and had bridges between those two buildings while the bridge has few boxes plot of the strata owners. Hanging property is not visible on the floor plan and site plan as it is external. Therefore, this property is seen as a 3D property which requires an identifier and should be classified. According to the Land Office, hanging properties owned by landowners or developers of buildings. However, the strata of the bridge were only revealed by the consent of each owner. For this building, UFI designated as apartment buildings, but a little different on the bridge (hanging properties) for which the code begin with 'J'.

Table 5. UFI Code for Hanging Properties

State	District	Town/City	Section	Lot No	Building	Floor	Plot
03	02	01	001	0001234	J01	002	0001
UFI	**03020100100012 34J01002001**						

Code for 'Floor' that represents floor level of the building was designated as type of apartment building. However, the code level of the bridge (hanging properties) is determined by the code level where the bridge (hanging properties) is located, such as '002' means that the hanging properties are on level two. Code for the strata parcel on bridge (hanging properties) shall be determined by the sequence of the first parcel on bridge (hanging properties) of the first building of 'M01' followed by the next parcel that connects on second buildings which is 'M02'. Table 5 above shows the coding structure of UFI for Hanging Properties building.

3D model for this type of buildings were built using SkecthUp 8.0 Hanging Properties structure has been made in accordance with the concept of the actual building. Figure 7 shows the Hanging Properties 3D Building made using Sketchup 8.0. Then, the 3D model building is exported to ArcGIS 10 software to develop a simple database and table attributes for UFI

code. Figure 8 shows 3D buildings of Hanging Properties by using the ArcGIS 10 and a simple query for UFI and parcel of strata buildings.

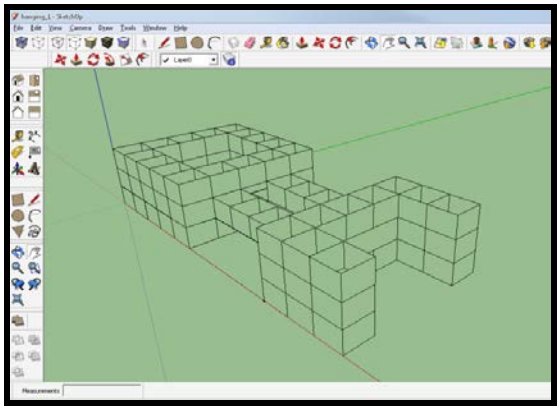

Figure 7. 3D Building of Hanging Properties by using SketchUp 8.0

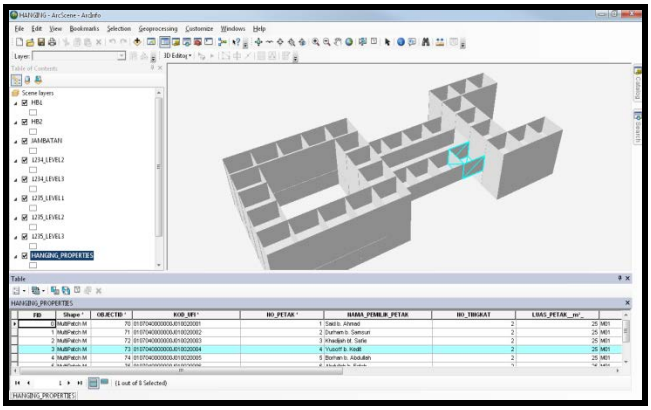

Figure 8. 3D Building of Hanging Properties by using ArcGIS 10

6. STORMWATER MANAGEMENT AND ROAD TUNNEL (SMART)

Figure 9. The dual purpose SMART

Figure 10. The SMART motorway alligment underneath lots of land parcel and building properties

Stormwater Management and Road Tunnel (SMART) is a project under the Federal Government initiated to alleviate the flooding problem in the city centre of Kuala Lumpur, the financial, business and commercial hub of Malaysia. The SMART system will be able to divert large volumes of flood water from entering this critical stretch via a holding pond, bypass tunnel and storage reservoir. However, at the design stage of SMART, the dual purpose (see Figure 9) concept was born from the initiative of the project proponents and the

motorway tunnel was integrated into the system to relieve traffic congestion at the main Southern Gateway to the city centre.

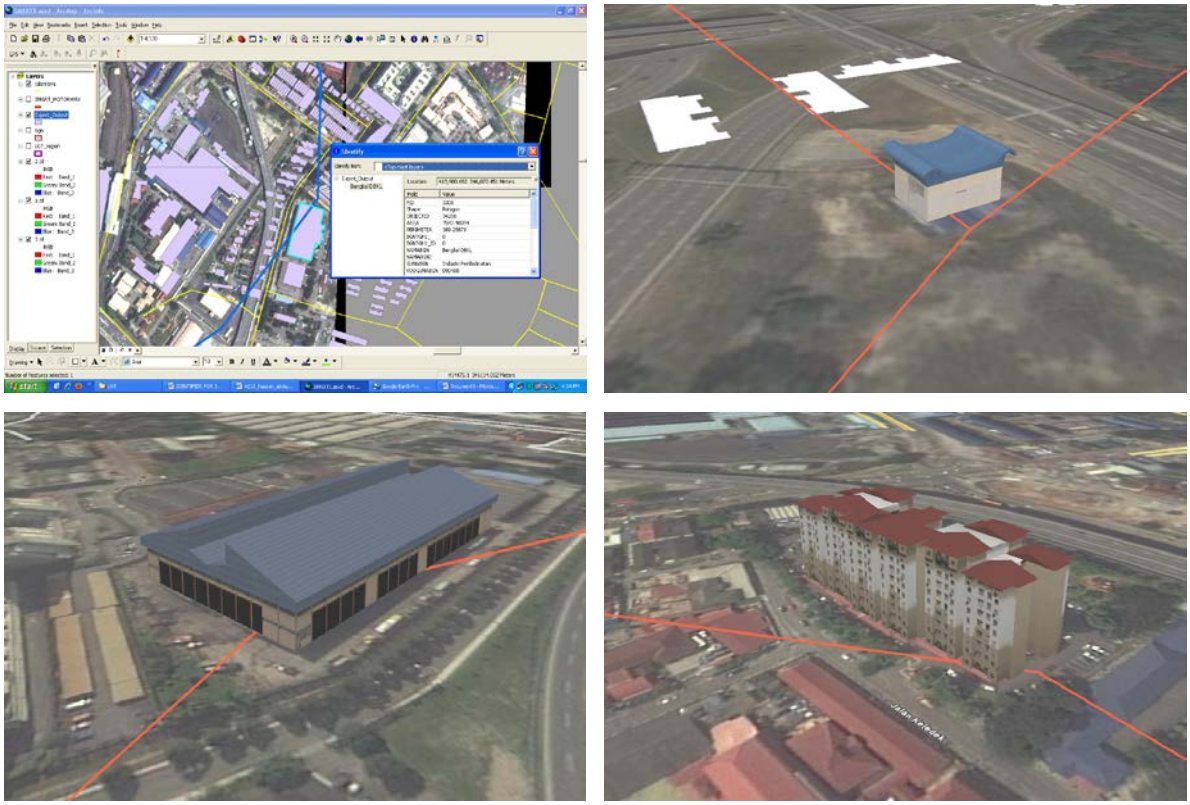

Figure 11. The land and building properties located above (on the land surface) the SMART alignment

The motorway tunnel will provide an alternative route for motorists to reduce traffic congestion from the Southern Gateway entering and exiting the city centre. The travel time will be reduced significantly from travel time is a mere four minutes compared to ten to fifteen minutes using the existing roads.

This tunnel have been develop with about 13meter outer diameter and approximately 20meter from the ground level with the length of motorway about 4km. Lots of land parcel and building properties located above the SMART motorway. Figure 10 shows the alignment of the SMART motorway on the land parcel and other building properties. Figure 11 show the land properties and building located above the SMART alignment. Current cadastre in Malaysia can only handle the 2D land parcel and properties while the building properties being registered under strata titled. The registration involving this SMART mega structure have to be done in a way that the cadastral system able to define multilayer of development. Surely 3D cadastral is needed in this situation.

7. CONCLUSION

In conclusion, the determination of UFI has been made after some research done on the concepts used in the UPI and some revision on current situation of 3D cadastre that being used in Malaysia. In addition, UFI has made the determination of three case studies mentioned on previous section. However, the determination of UFI is closely related to the rights, responsibility and restrictions, which it uses a hybrid approach that integrated the two agencies including the JUPEM and the LO which is maintaining the current 2D registration and add 3D component into registration system. In general, Malaysia is able to use the 3D cadastre system because it has well developed 2D cadastre systems. Solution of 3D cadastral registration is to study the possibility of solutions in adding 3D component of the current registration. Thus, UFI can be used for the 3D object identification for each cadastre. However, there still lots of work to be done in order two have complete solution of having 3D Cadastre for Malaysian concerning new development such as SMART.

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BIOGRAPHICAL NOTES

Muhammad Imzan Hassan for the first time he joint into geographical field after he finished his Diploma in Land Survey. After few years working experienced he continued his study in Geoinformatic as his Bachelor Degree and graduated on 2001. Then he joints a group of offshore members working on seismic data acquisition and oil drilling as a hydrographic surveyor and spatial data handler. Later he received an offer from Universiti Teknologi Malaysia to join them as academic members on 2002. He obtained his MSc degree in Geoinformation from International Institute for Geo-Information Science and Earth Observation, ITC, Enschede on 2004. Currently, he is finishing his PhD study on 3D Cadastre area at Universiti Teknology Malaysia.

Alias Abdul Rahman is a Professor at the Department of Geoinformatic and Dean for Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia (UTM), Skudai, Johor. He received a degree in Surveying and Mapping Sciences from North East London Polytechnic, England, UK in 1987, Postgrad Diploma in GIS from ITC, Netherlands, and MSc in GIS also from ITC, Netherlands. In year 2000 he received PhD degree from University of Glasgow, Scotland, U.K. Currently he serves as Chair for ISPRS Commission II/5 from 2008 – 2012 on Multidimensional GIS and Mobile Data Model.

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