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SUMMARY

A country profile based on LADM has been conceptualised in the last few years as part of joint research efforts between the Department of Survey and Mapping Malaysia (JUPEM) and Universiti Teknologi Malaysia (UTM). The LADM conceptual model covers various aspects of spatial data components available in the mapping agency (JUPEM), including data from Land Office e.g. land registration. The Malaysian LADM country profile covers various classes of spatial unit including strata objects classes such as *MY_Building, MY_ParcelUnit, MY_AccessoryUnit, MY_CommonPropertyUnit, MY_LimitedCommonPropertyUnit* and *MY_LandParcel.* This paper discusses one experiment of converting the available building strata schema into LADM model, specifically *MY_SpatialUnit* for 2D and 3D. The existing building strata schema was developed based on XML syntax. The entire workflow of the experiment will be demonstrated where conversion of file with strata XML data collected from the field into the database with LADM data model, and then 3D visualization. We also plan to investigate the potentials of implementing topological connections in the conversion. It is anticipated that the developed conversion and integration modules could serve as an initial research towards a bigger scope of work for near-future LADM compliance model for the mapping agency and other stakeholders.

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1. INTRODUCTION

National mapping agency (NMA) of Malaysia i.e. the Department of Survey and Mapping Malaysia (DSMM) has been engaged with inititiative for managing strata objects and the related information. The strata objects such as parcels for units within highrise buildings and other properties were captured by land surveyors with basic dimensions of the units including individual heights of the unit. Those are some of the objects and stored as XML syntax. Recently, the DSMM adopted ISO standard called Land Administration Domain Model (LADM) as reported by Zulkifli et al (2014). This paper describes experimental work – converting strata building to LADM. The strata objects are in XML format for each development area (i.e. schema, design) in a seperate file.

The remaining sections of this paper discuss strata title and LADM in section 2. XML data files conversion describes in section 3. We will highlight our near future work for the bigger picture of the LADM project in the country in section 4 and conclusions.

2. STRATA TITLE AND LADM

This section discusses on 3D strata objects registration and modelling for strata objects within Land Administration Domain Model (LADM) framework. A LADM conceptual model for strata objects have been proposed and developed for Malaysia (ISO, 2012). The LADM provides a conceptual model to build concrete application including 3D strata objects registration (Lemmen, 2012). Strata Title Act 1985 (STA 1985) was the first piece of legislation passed to specifically govern subdivision of buildings into parcels and the subsequent issuance of strata titles in Peninsular Malaysia. Though commendable, the STA 1985 proved insufficient over time particularly in covering the aspect of management of subdivided buildings. This then led to the enactment of Building & Common Property (Maintenance & Management) Act 2007 to specifically address the issue of maintenance and management of high-rise buildings and their common property by developers followed by Joint Management Body (JMB) and Management Corporation (MC).

In 2015, Strata Acts – Strata Titles (Amendment) Act 2013 and Strata Management Act 2013, were brought into force. The STA 2013 extends the application of STA 1985 to the Federal Territory of Labuan. Provisions in STA 1985 are amended and harmonized with the National Land Code (National Land Code, 1965). STA 2013 has also carved out all the provisions regarding management of subdivided building under the STA 1985 and placed it purely under the governance of Strata Management Act 2013. The implementation of the SMA 2013 is complemented by the Strata Management (Maintenance & Management) Regulations 2015.

The new Acts require developer to fulfill certain pre-requisites before obtaining Certificate of Share Unit (CSU). This is to ensure that the process for the application of the Strata Title can be carried out efficiently and to achieve vacant possession with simultaneous delivery of Strata Title.

A new provision under the Strata Title (Amendment) Act 2013, now requires the developer to apply and obtain a Certificate of Proposed Strata Plan (CPSP) from the Director of Survey in JUPEM. The developer needs to apply for Strata Titles within one month after the issuance of CPSP. Thus, upon the delivery of the vacant possession, the Strata Title will be simultaneously delivered to the purchaser. The Malaysian LADM country profile includes the support for these strata objects: building and building parts (all in 3D within a single lot), land parcel (with house no more than 4 storeys within a single lot), parcel unit, accessory unit, and common property unit including support for provisional, multilayer and underground aspects. By developing a Malaysian country profile based on the international standard ISO 19152 (Zulkifli et al., 2014), the possible confusion related to terminology (e.g lots, parcels, strata) has been resolved.

This is not only important for Malaysia, but also useful for many other countries, that have the same title system. Therefore, in the upcoming revision of ISO 19152, the more detailed conceptual model for strata objects could be proposed at part of the future standard, either as being normative or informative. In Malaysia, a master lot can be subdivided into smaller lots for the purpose of establishing a strata scheme (scheme refers to any development area for strata). Subsequently, the strata scheme lot can be subdivided into parcels and land parcels. Each parcel and land parcel can consist of an individual apartment or house. A building intended for subdivision into parcels means any building or buildings having two or more storeys in a development area and intended to be subdivided into parcels; and any development area has two or more buildings intended to be subdivided into land parcels.

Figure 1 illustrates the LADM model of strata objects (with blue colour) in Malaysia. A *parcel* in relation to a subdivided building, means one of the individual units comprised therein (apartment or condominium), which is held under separate strata title. An *accessory unit* means a unit shown in a strata plan, which is used or intended to be used in conjunction with a parcel. A *common property* means so much of the lot as is not comprised in any unit (including any accessory unit), but shared among the involved strata title owners. A *limited common property* means common property designated for the exclusive use of the owners of one or more strata lots. A *land parcel* may share basement, accessory unit and common property. In the model, one strata object type remains in 2D, *MY_LandParcel*.

The other strata objects are all proposed to be 3D and therefore inherit from an abstract class *MY_Shared3DInfo*, with strata specializations (i.e. *MY_BuildingUnit*, *MY_ParcelUnit*, *MY_AccessoryUnit*, *MY_CommonPropertyUnit* and *MY_LimitedCommonPropertyUnit*. As there can be several limited common property's in one common property, this is modelled as a part of relationship to *MY_CommonProperty*. In this paper, Extensible Markup Language (XML) Schema is used to define strata objects data structure, and also define the elements and their content, data type, number and order of appearance. Figure 2 shows the file with data according to the XML Schema (strata.xsd) of the strata objects.

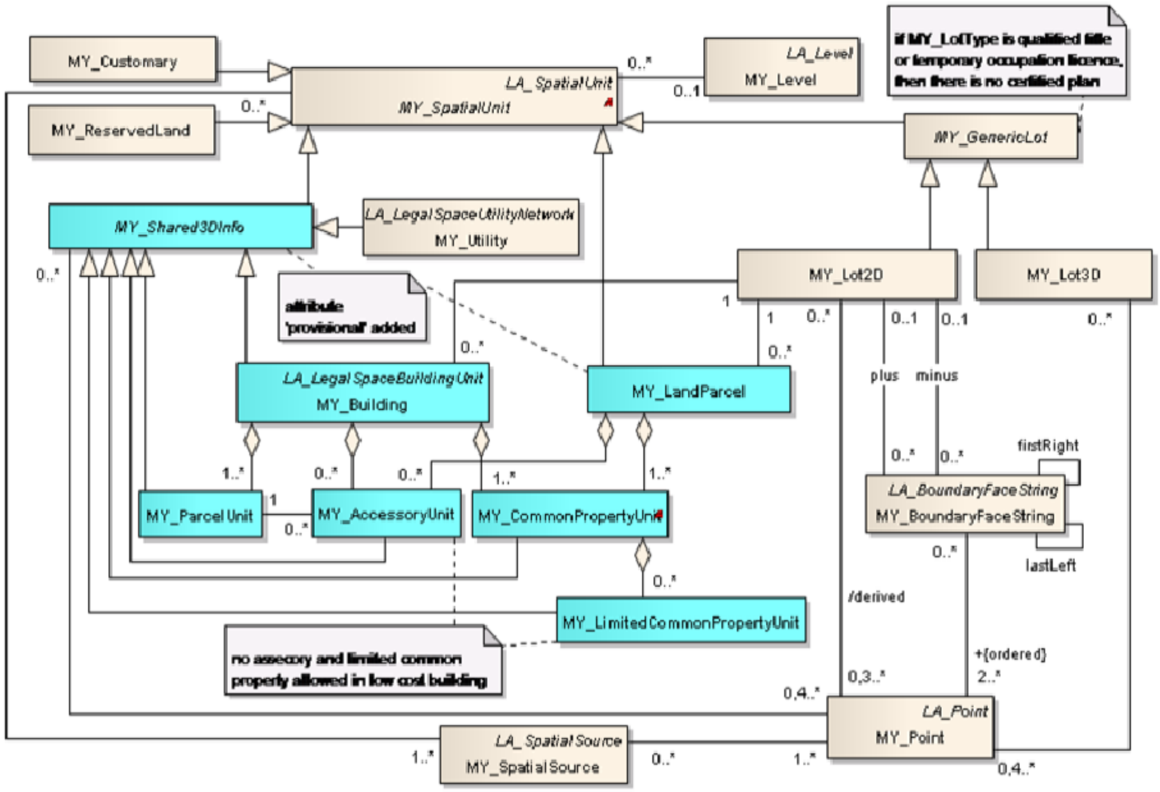

Figure 1: LADM model of strata objects (with blue colour) in Malaysia

```
<?xml version="1.0" encoding="UTF-8"?>
- <Strata xsi:noNamespaceSchemaLocation="strata.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.jupem.gov.my/strata/ekadas_gdm2000">
  - <Scheme nama_pemilik_asal="UDA HOLDINGS BERHAD (347508-T)" jenispembangunan="1" pab_folio="24" pab="PA(B)125481" nojadualpetak="125481" nosijilakuan="rj1000"
    no_bukukerja_luar_folio="10" no_bukukerja_luar="6" tarikh_lulus_cpsp="2013-10-11" no_sijil_cpsp="" jumlah_unit_syer="160227" kodtujuanukur="17"
    no_fail_ukurlot="PUBLWP33_2012" no_ruj_ljt="044500052" no_ruj_jubl="JS2.10W008" lokasi="JALAN BANGSAR UTAMA 1, KUALA LUMPUR" nama_projek="GAYA BANGSAR"
    alamat_perbadanan_pengurusan="MENARA BB PLAZA, LOT 111, JALAN BUKIT BINTANG" nama_perbadanan_pengurusan="UDA HOLDINGS BERHAD" alamat_pemaju="MENARA
    BB PLAZA, LOT 111, JALAN BUKIT BINTANG" nama_pemaju="UDA HOLDINGS BERHAD" bayaran_pelan="" bayaran_ukur="" tarikh_lulus_permohonan="2013-10-11"
    tarikh_terima_sijil_akuan="2013-10-11" bilangan_aksesori_kr="0" bilangan_aksesori="5" bilangan_petaktanah="0" bilangan_petak_kr="0" bilangan_petak="1" tarikh_siap="2013-05-
    10" pengukur_noic="761003101234" diukur_oleh="Sr Zul Majid Mokhtar Bazin" no_fail_ptg="PTG/WP20/3455/2013" no_fail_pt="" no_fail_ukurstrata="PUBLWPB30_2013"
    luas="5123.000" no_hakmilik="PN48878" pa="PA1107905" skim="(S)3998" lot="380" seksyen="096" mukim="44" daerah="00" negeri="14">
    - <Block is_kr="N" unitsyer="160227" namalainbangunan="" kodkegunaanbangunan="BA0010" blocktype="B" sijilno="" height="3.5" no_of_tingkat="1" upi="140044096380(S)
      3998(B)M1(M)0" blockno="(M)0" bangunanno="(B)M1">
        <Tingkat height="3.200" upi="140044096380(S)3998(B)M1(M)0(T)5" keratan_groupid="" namalaintingkat="" altitude="15.000" unit="M" area="0.00"
          no_of_aksesori_kr="0" no_of_aksesori="1" no_of_petak_kr="0" no_of_petak="0" tingkatno="(T)5" blockupi="140044096380(S)3998(B)M1(M)0"/>
        <Tingkat height="4.800" upi="140044096380(S)3998(B)M1(M)0(T)7" keratan_groupid="" namalaintingkat="" altitude="21.400" unit="M" area="0.00"
          no_of_aksesori_kr="0" no_of_aksesori="1" no_of_petak_kr="0" no_of_petak="0" tingkatno="(T)7" blockupi="140044096380(S)3998(B)M1(M)0"/>
      - <Tingkat height="3.500" upi="140044096380(S)3998(B)M1(M)0(T)9" keratan_groupid="" namalaintingkat="" altitude="31.900" unit="M" area="1300.00"
        no_of_aksesori_kr="0" no_of_aksesori="3" no_of_petak_kr="0" no_of_petak="1" tingkatno="(T)9" blockupi="140044096380(S)3998(B)M1(M)0">
        - <Petak pab="PA(B)125481-24" is_kr="N" unitsyer="1091" height="3.500" upi="140044096380(S)3998(B)M1(M)0(T)9(P)286" rastertable="" namapetak=""
          kodkegunaanpetak="REU1" folio="0" a_unit="M" jp_area="179" a_area="179.00" g_area="179.203" petakno="(P)286">
          - <boundary unit="M" isislandlot="false" guid="MJ79fcdfe75d3547468d66b5a49a2dc" a_distance="1.787" g_distance="1.787" bearing="39.1238"
            petakupi="140044096380(S)3998(B)M1(M)0(T)9(P)286">
              <vertex isislandlot="false" guid="MJa87ceeef11a44f8aa41e354625bb3" petakupi="140044096380(S)3998(B)M1(M)0(T)9(P)286" y="-61156.111"
                x="18910.387"/>
              <vertex isislandlot="false" guid="MJ099b49ff83c944d8914c22b551644" petakupi="140044096380(S)3998(B)M1(M)0(T)9(P)286" y="-61154.726"
                x="18911.517"/>
            </boundary>
```

Figure 2 : XML (strata.xsd) of the strata objects data

By analysis of the current XML strata data, it contains the following information: schema, block, '*tingkat*' or floor, parcel, accessory, common area and land parcel. Where, each information is contains their own attributes. Based on the developed Malaysian LADM country profile (Zulkifli, 2014; Zulkifli et al., 2015), block is refer to *MY_Building* class, parcel refer *MY_ParcelUnit* class, accessory refer to *MY_AccessoryUnit* class, common area refer to *MY_CommonPropertyUnit* class and land parcel refer to *MY_LandParcel* class. Two strata objects are missing (i.e. scheme and floor). However, it can be derived using Unique Parcel Identifier (UPI). For examples, UPI for parcel unit is 4004404096380(S)3998(B)M1(M)0(T)9(P)286 as highlighted in Figure 2. So, the scheme number for the parcel unit is 3998 and the '*tingkat*' or floor number is 9. The detail information for UPI can refer to Zulkifli et al., (2013). In this paper, a process to convert the file with current strata XML object to database according to LADM standard specifications will be brought forward. In order to convert the XML data, C# is used to implement and query the information based XML-encoding. The detail of the conversion process will be explained in the next section.

3. XML STRATA FILES CONVERSION

3.1 The study area

Three different datasets were used in the experiment, namely, *Gaya Bangsar*, J*alan Wangsa Delima* and current development of Canning Business Centre (Ipoh City). The first *Scheme* was *Gaya Bangsar* (filename: 5035.xml - internal file at JUPEM) located along *Jalan Bangsar Utama 1*, Kuala Lumpur. The *Scheme* consists of one block of building with 36 number of floors (Figure 3).

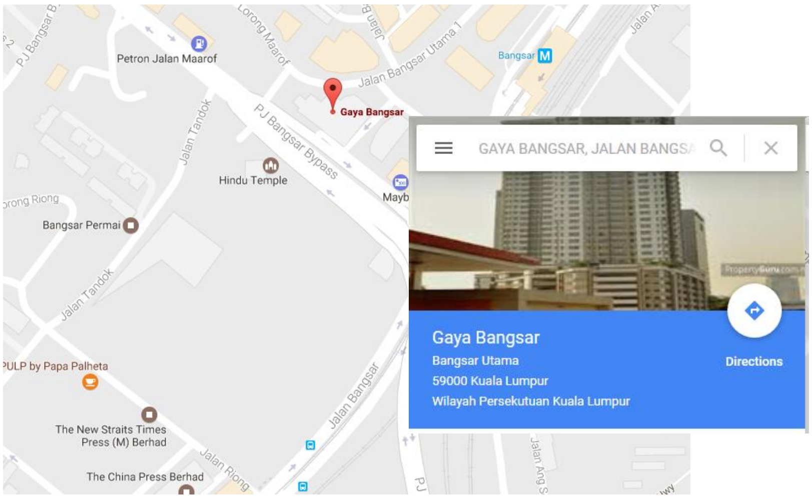

Figure 3: The location of Gaya Bangsar

The second dataset is the development of 224 office units (filename: 5019.xml) for commercial use alongside Jalan Wangsa Delima, Wangsa Maju, Kuala Lumpur. The scheme consists of one main building of 20 floors (Figure 4). Figure 5 shows the location of the development of Canning, Ipoh City (filename: 2500.xml).

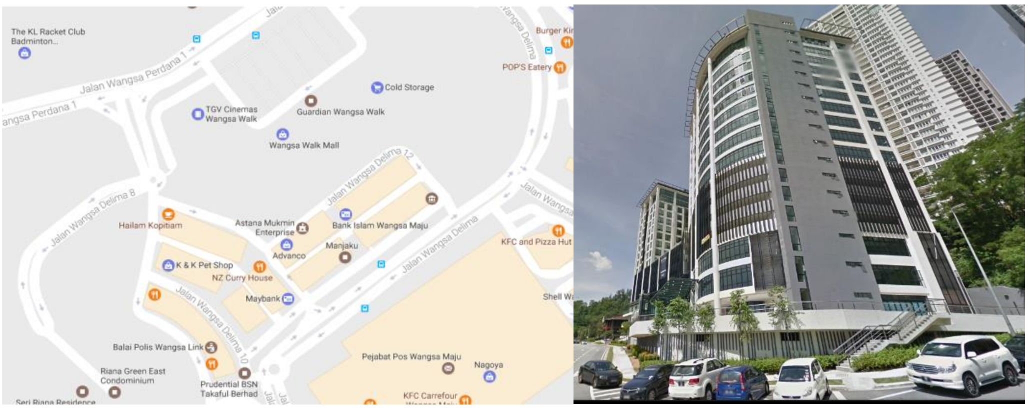

Figure 4: The location of Jalan Wangsa Delima

Figure 5: Location of Pusat Perniagaan Canning, Ipoh City.

3.2 Strata XML and LADM Context

The context of Strata XML and LADM is shown in appendix A. These tables demonstrate the relation of strata context with the LADM. Some missing attributes are currently excluded in the current conversion such as is_KR (*Kos Rendah* - Low Cost). In future, more attributes should be added to incorporate more strata attributes. For more information, see appendix B and C.

3.3 Conversion of Strata XML

Strata XML is currently a custom format for defining properties and attributes related to strata. The top class of Strata XML is defined as *scheme*, followed by *block*, *tingkat* (floor), *petak* (parcel), *common area*, *aksesori*, *landparcel*, etc. Relevant developers produce and submit XML based on the defined requirements by JUPEM, and validated via XML validator. This experiment is based on Strata XML version 7.6 (current version). Mapping of the elements to LADM is quite straightforward nonetheless some attributes of the Strata XML are not related to LADM core. In the future it has to be decided if these attribute are still needed since some of the attributes are redundance and can be retrieved from UPI. In this experiment, the Malaysian Country Profile of LADM was used as the base model. Each strata element was mapped to MY_LADM classes. The block data comprises series of X and Y coordinates with height values that could be further constructed into 3D representation using MY_Lot3D.

3.4 The Conversion Flow

Currently the input data for this experiment is from file with Strata XML. The initial process of the conversion is to create Strata Dictionary using v7.6 of Strata XSD. MY_LADM elements, enums, attributes are loaded into LADM Dictionary. XMLReader reads through Strata XML and stores information in the memory. By referring to the prebuilt context mapping dictionary, elements, attributes and geometries are matched and related (see Figure 6). In-memory information will then be loaded into memory-XML using XMLDocument Loader. At this stage, the XML information is replaced with MY_LADM related elements and attributes.

On the other hand, geometries are extracted. Boundaries and vertices of Strata XML is mapped by the given Unique Parcel Identifier (UPI). On top of the provided UPI from Strata XML, boundary of strata is mapped as BoundaryFace while vertex as Point; from this experiment, the UPI was extended to include the information of *BoundaryFace* by adding *(BF)* identifier and Point by adding *(V)* identifier. Example of a ParcelUnit UPI is similar to *080343000107641(S)2500(B)M1(M)0(T)1(P)9(BF)1|2|3|4|* where character '|' as separation of indices. Similar to boundary element, the UPI is shown as *080343000107641(S)2500(B)M1(M)0(T)1(P)9(BF)1|* for first boundary and so on. With this information, extracted geometries is then able to be mapped along with the converted MY_LADM attribute.

In this experiment, geometries are extracted and saved as OBJ format. In OBJ format, faces are stored in sequence of vertex indices while vertices are stored in sequence of X,Y and Z. Both faces and vertices are associated within the OBJ document. For visualization purposes, the OBJ file is then converted to gLTF for CESIUM visualizer. While COLLADA is converted from OBJ and stored as MULTIPATCH data structure in the database, where both the geometry and attributes are stored according to the Malaysian LADM country profile.

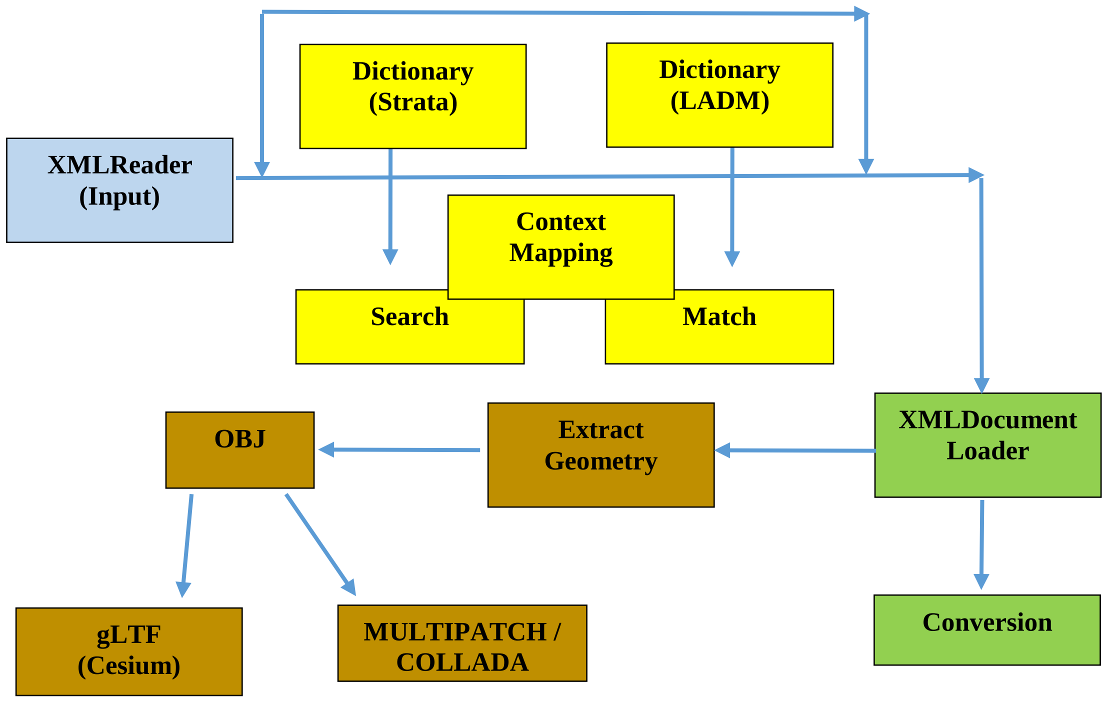

Figure 6: Conversion flow from Strata XML to LADM MY_SpatialUnit.

3.5 Extended UPI for Geometry

As briefly discussed in the previous section, the connectivity of geometries with the MY_LADM information is based on the extended UPI. The additional *BF* for boundaries and *V* for points allow direct identification of geometries based on the UPI itself. Therefore, by using such approach, each extracted geometries can be associated with the boundaries without redundancies.

3.6 The Interface

Figure 7 illustrates the interface of the conversion program. Currently the converted file will be stored into the same path of the input data (XML file). On the other hand, we could visualize the object in this interface with the propose data structure. In this experiment, visualization is done in Cesium (as illustrated in Figure 9).

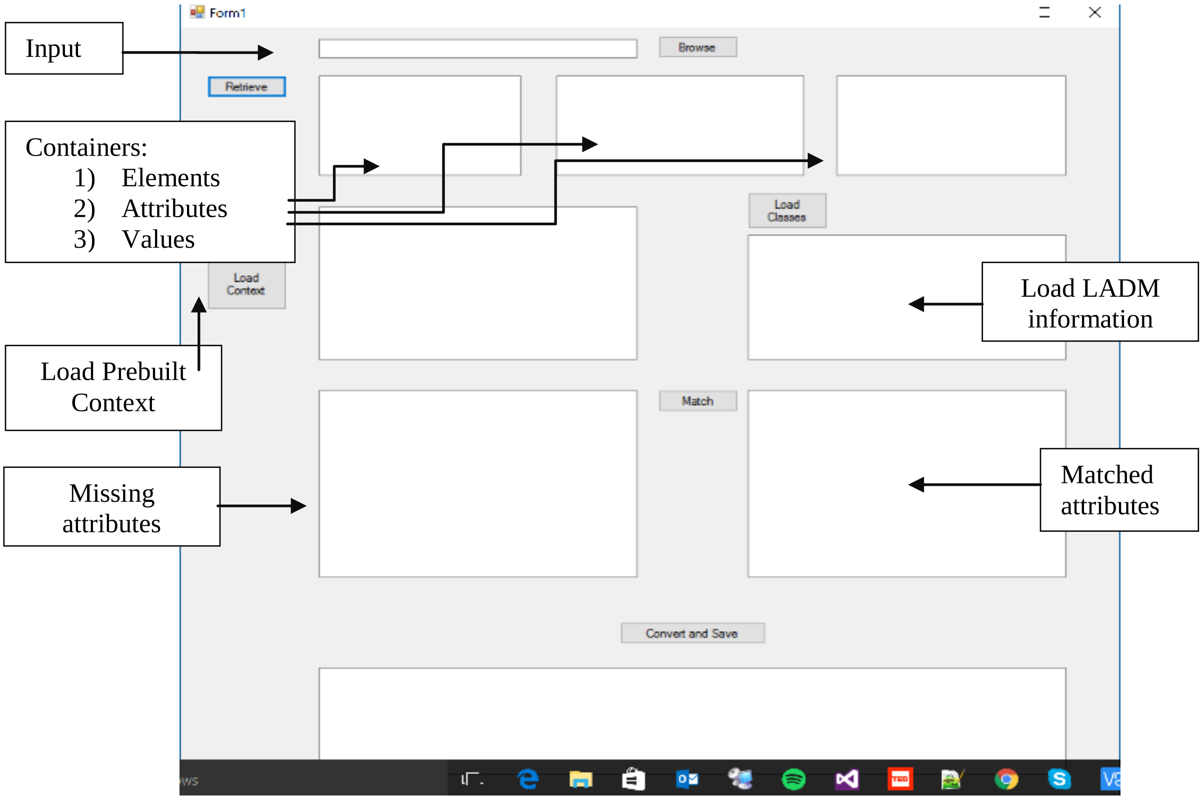

Figure 7: The interface for the conversion program

3.7 The Output of the Converted XML and Visualization

The conversion process produces OBJ / COLLADA / gLTF geometries format (see Figure 9). However, this approach has some limitations in the aspect of:

i. Topology, sharing primitives in a well defined structure (avoiding redundancies);
ii. Imperfect visualization for MULTIPATCH data structure (tetrahedra lines seen on top of the solid cube, see Figure 8);
iii. Less primitive elements, such as, no points or lines can be selected when selecting polygon/line or vertex (entire block will be selected, similar to attribute information);

Thus, a new data structure could be proposed to solve those limitations.

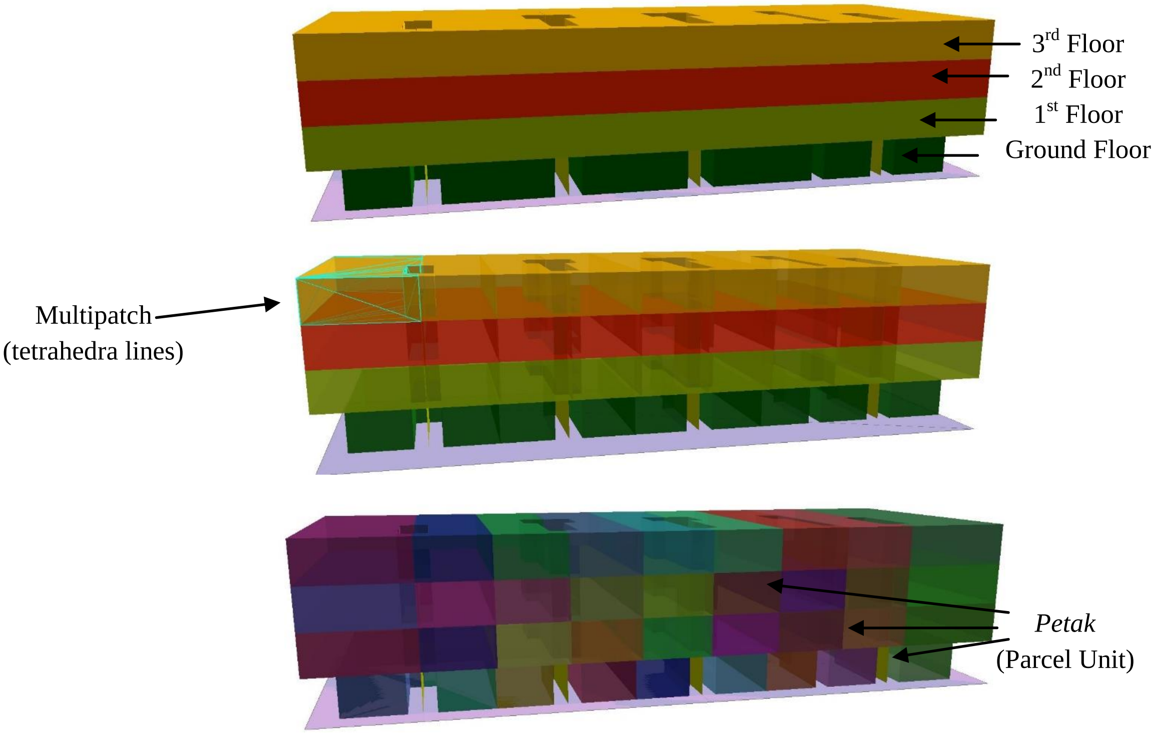

Figure 8: The model of test sample from Strata XML (multipatch 2500.xml)

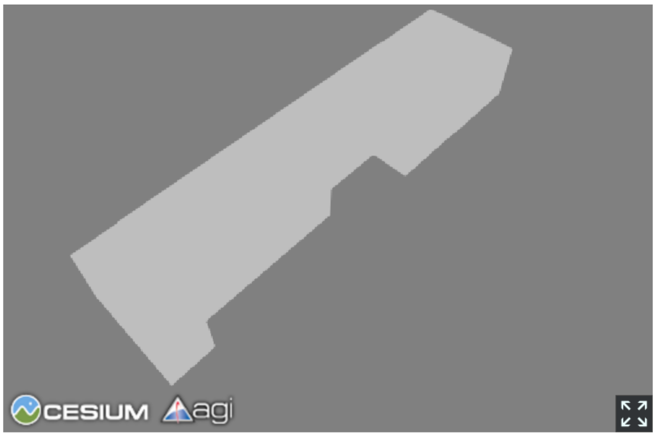

Figure 9: The 3D model visualization of a *Petak* (a single parcel unit) based on gLTF format.

The following section describes a possible system that incorporates the elements discussed in the previous sections - strata XML conversion, LADM MY_SpatialUnit compliance, simple and fragmented 3D visualization form the converted XML files (without spatial database and RRR - rights, restrictions and responsibility information).

4. THE PROPOSED SYSTEM

4.1 3D Rendering on the Web

The advancement of web 3D standards has made it possible to display 3D content on the web without the need of plug-ins. The visualization of 3D building models on the web raises a broader issue: the rendering of 3D content on the web. A number of emerging technologies have been developed in the last few years. A development of Web3D GIS based on Cesium by He et al. (2016), a complete state-of-the-art has been proposed by Evans et al. (2014), CityGML with WebGL by Gesquière and Manin (2012). While the X3DOM by Behr et al. (2009) and XML3D by Sons et al. (2010) are the two popular XML standard formats for 3D browser-based rendering. A X3D based 3D web-viewer for a 3D Cadastre prototype was developed in the Russian Federation by Vandysheva et al. (2012).

We present a framework based on a solution of a light server and heavy client architecture (Gesquière and Manin, 2012). With this solution, it can manage a large number of clients. Nowadays, the increasing capacity of client devices offers the possibility of transferring processes client side. Figure 10 shows the representation of our proposed system architecture.

The system architecture consists of two parts: web client and 3D database server. On client side, OpenLayers provides two-dimensional map services. The client and the server are developed in JavaScript and PHP. The system utilizes Cesium library to render the 3D building models. In server side, a back-end API for retrieving building properties from external database (e.g. Land Office and National Property Information Centre) was developed using PHP. The API also retrieves cadastral information from existing NDCDB (National Digital Cadastral Database) database.

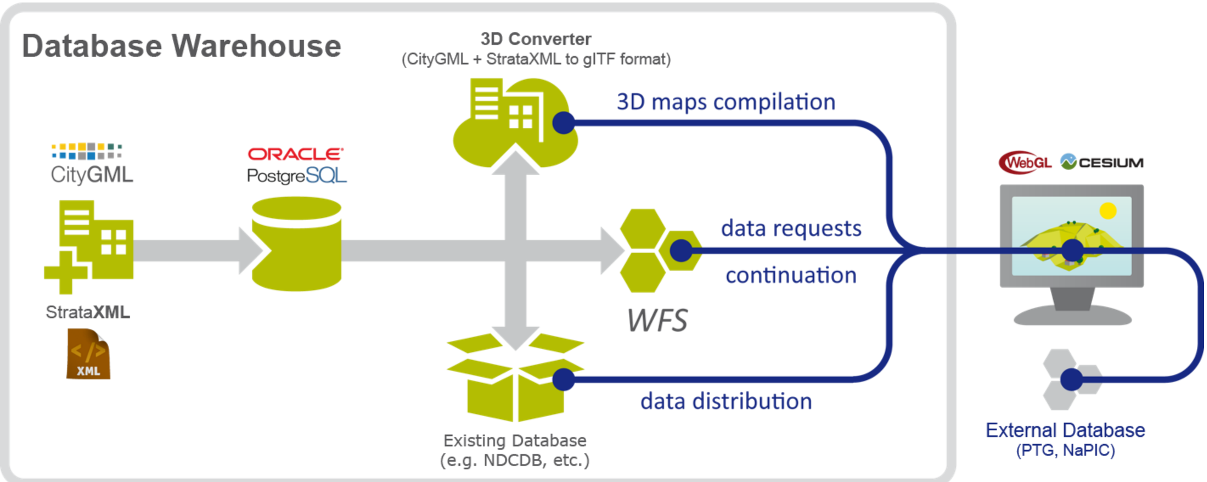

Figure 10: Proposed System Architecture.

The 3D building model includes strata-layer of a building complete with the building's furniture such as common utility area, elevators, etc. (this is used as reference for the legal spaces). The 2D cadastral map layer from PostgresSQL is loaded from GeoServer as a web map service (WMS). Using the two-dimensional map service is to simplify display details and improve the display speed. The 3D building models is then managed in 3D Building database (stored in PostgreSQL) and published via WFS which will be called by Cesium. This helps to achieve cross-platform of 3D building models in a three-dimensional panorama display.

Cesium is an open-source JavaScript library built on the Web Graphics Library (WebGL) for interactive visualization of 3D globes and 2D maps in a web browser. WebGL is a web standard, designed and maintained by the Khronos Group (www.khronos.org), for low-level 3D graphics Application Programming Interface (API) based on OpenGL ES 2.0 – a standard API for 2D and 3D graphics on embedded systems (He et al., 2016).

4.2 The data structure

Technically, each spatial object is made up of geometrical structures (together with other alphanumerical attributes and associations, as defined in LADM). This geometrical information describes the nature, shape or the outline of the objects in a real world. Moreover, any projected geometrical structure into a specific geographical coordinate system will make the data useful to users in a specific application (2D, 3D or nD). In this research, the applied methodology for visualization was from (OBJ to COLLADA) and (OBJ to gLTF) format as illustrated in Figure 8 and 9 respectively.

We've discovered that the disadvantages of the visualization approaches e.g. lacking in preserving the topology information in the conversion process. Whereby, this information is needed prior to any executed geographic analyses. Secondly, due to the Multipatch data structure where lines are seen even for solid polygons. Furthermore, the structure lacks in primitive elements, such as no points or no lines or no polygon can be selected e.g. for a cube (entire cube will be selected, similar to attribute information).

Any geometrical structures without its relationships between spatial objects (topological relationships) will be facing spatial analyses constrains. Topological information is needed in order to "relate" the connectivity among spatial objects for analyzing the real world issues such as land management transactions. Therefore, a data structure that can preserve topological information and be able to support primitive objects would be a better framework for visualization in future land management transactions.

5. CONCLUSIONS

We have developed a Malaysian LADM country profile that covers most of land management both within spatial and RRR components. One of the goals is to be able to incorparate building strata objects into the LADM conceptual model that able to generate relevant information for the relevant users and units within the authorities. Our XML strata data files conversion to LADM module works with 3D visualization. We plan to utilize this conversion module for our future 3D LADM works. We anticipate this particular project could be extended with integration of existing 2D databases (NDCDB) and other 3D objects via new data structure (including topology).

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Appendix A:

***Scheme*, Block, *Petak*, *Aksesori*, Common area and Land parcel association** (XML file)

SCHEME	
Element	**Association**
Negeri	MY_LOT2D : state
Daerah	MY_ LOT2D : district
Mukim	MY_ LOT2D : mukim
Seksyen	MY_ LOT2D : section
Lot	MY_ LOT2D : lotNo
Skim	-
PA	MY_SPATIALSOURCE : sID
No_Hakmilik	MY_ADMINISTRATIVESOURCE : sID
Luas	MY_ LOT2D : officialArea_m2
No_Fail_UkurStrata	MY_ SPATIALSOURCE : fileNumber
No_Fail_PT	MY_ ADMINISTRATIVESOURCE : fileNumber
No_Fail_PTG	MY_ ADMINISTRATIVESOURCE : fileNumber
Diukur_Oleh	MY_PARTY : name
Pengukur_NoIC	MY_ PARTY : pID
Tarikh_Siap	MY_ SPATIALSOURCE : submission
Bilangan_Petak	My_BUILDING : totalPrcelNo
Bilangan_Petak_KR	-
Bilangan_PetakTanah	-
Bilangan_Aksesori	-
Bilangan_Aksesori_KR	-
Tarikh_Terima_Sijil_Akuan	MY_ SPATIALSOURCE : acceptance
Tarikh_lulus_permohonan	MY_ SPATIALSOURCE : submission
bayaran_ukur	-
bayaran_pelan	-
Nama_pemaju	MY_PARTY : name
Alamat_pemaju	-
Nama_perbadanan_pengurusan	MY_ PARTY : name
Alamat_perbadanan_pengurusan	-
Nama_projek	-
Lokasi	-
No_Ruj_Jubl	MY_ SPATIALSOURCE : source
No_Ruj_LJT	MY_ SPATIALSOURCE : source
No_fail_UkurLot	MY_ SPATIALSOURCE : fileNumber
KodTujuanUkur	MY_ SPATIALSOURCE : measurement
Jumlah_Unit_syer	MY_RIGHT : share
No_Sijil_CPSP	MY_ SPATIALSOURCE : source
Tarikh_Lulus_CPSP	MY_ SPATIALSOURCE : acceptance
No_Buku_Kerja_Luar	MY_ SPATIALSOURCE : measurement
No_Buku_Kerja_Luar_Folio	MY_ SPATIALSOURCE : measurement
NoSijilAkuan	MY_ SPATIALSOURCE : source
NoJadualPetak	MY_ SPATIALSOURCE : source
PAB	MY_ SPATIALSOURCE : sID
PAB_Folio	MY_ SPATIALSOURCE : source
JenisPembangunan	MY_LOTUSETYPE : use
Nama Pemilik Asal	MY_PARTY : name

BLOCK	
Element	**Association**
BangunanNo	-
BlockNo	-
UPI	MY_BUILDING : suID
No_Of_Tingkat	MY_BUILDING : totalFloorNo
Height	MY_BUILDING : height
SijilNo	MY_SPATIALSOURCE : source
BlockType	MY_BUILDING : provisional
KodKegunaanBangunan	MY_BUILDINGTYPE : type
NamaLainBangunan	-
UnitSyer	MY_RIGHT : share
Is_KR	-

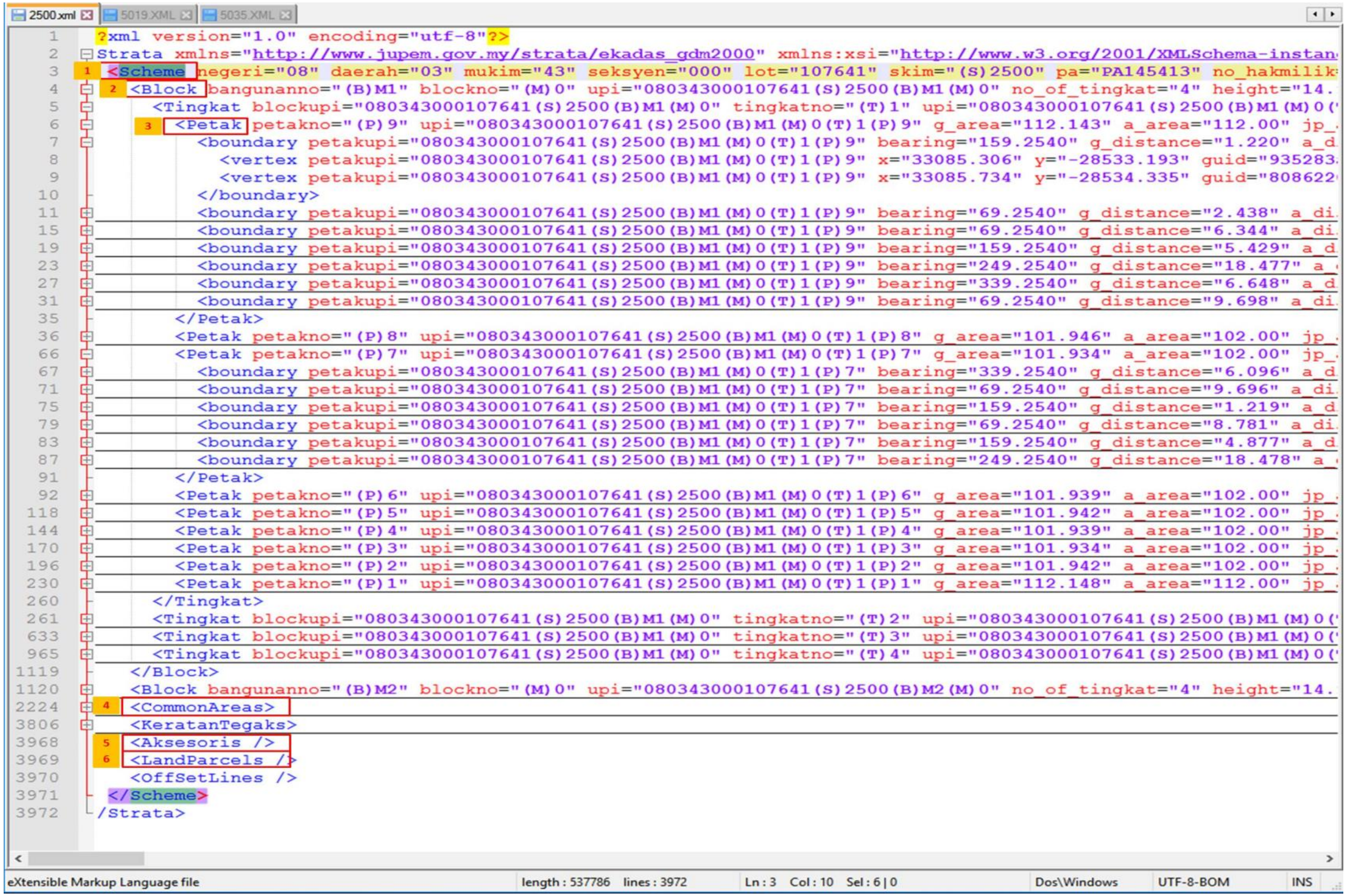
PETAK	
Element	**Association**
PetakNo	-
UPI	MY_PARCELUNIT : suID
G_area	MY_PARCELUNIT : area_m2
A_Area	-
JP_Area	-
A_Unit	-
Height	-
PAB	MY_SPATIALSOURCE : sID
Folio	MY_SPATIALSOURCE : source
KodKegunaanPetak	MY_PARCELUNITTYPE : type
NamaPetak	-
RasterTable	-
UnitSyer	MY_PARTYMEMBER : share
Is_KR	-

AKSESORI	
Element	**Association**
AksesoriNo	-
UPI	MY_ACCESSORYUNIT : suID
G_area	MY_ ACCESSORYUNIT: area_m2
A_Area	-
JP_Area	-
A_Unit	-
Height	-
PAB	MY_SPATIALSOURCE : sID
Folio	MY_SPATIALSOURCE : source
PetakUPI	MY_PARCELUNIT : suID
PetakType	MY_ACCESSORYUNITTYPE : type
NamaPetak	-
UnitSyer	MY_PARTYMEMBER : share
Is_KR	-

LANDPARCEL	
Element	**Association**
LandParcelNo	-
UPI	MY_LANDPARCEL : suID
G_area	MY_ LANDPARCEL: officialArea_m2
A_Area	MY_ LANDPARCEL: surveyedArea_m2
JP_Area	MY_ LANDPARCEL: calculatedArea_m2
A_Unit	-
Height	-
PAB	MY_SPATIALSOURCE : sID
Folio	MY_SPATIALSOURCE : source
NamaPetak	-
UnitSyer	MY_PARTYMEMBER : share
KodKegunaanPetak	-

COMMONAREA	
Element	**Association**
CommonAreaNo	-
UPI	MY_COMMONPROPERTYUNIT : suID
G_area	MY_ COMMONPROPERTYUNIT: area_m2
Height	-
PAB	MY_SPATIALSOURCE : sID
Folio	MY_SPATIALSOURCE : source
PetakType	MY_ COMMONPROPERTYUNIT : type
NamaPetak	-

Appendix B: The Strata Scheme (XML syntax)



```
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    <Tingkat blockupi="080343000107641(S)2500(B)M1(M)0" tingkatno="(T)4" upi="080343000107641(S)2500(B)M1(M)0('
  </Block>
  <Block bangunanno="(B)M2" blockno="(M)0" upi="080343000107641(S)2500(B)M2(M)0" no_of_tingkat="4" height="14.
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  <KeratanTegaks>
  <Aksesoris />
  <LandParcels />
  <OffSetLines />
 </Scheme>
/Strata>

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```

APPENDIX C: Malaysian country profile (MY_SpatialUnit, temporary classes for conversion in grey colour)