

## Web Visualization of 3D Strata Objects based on CityJSON and LADM

\*Faraliyana Hanafi, Imzan Hassan, Alias Abdul Rahman,  
Hanis Rashidan  
3D GIS Research Lab, UTM (Malaysia)

# Content

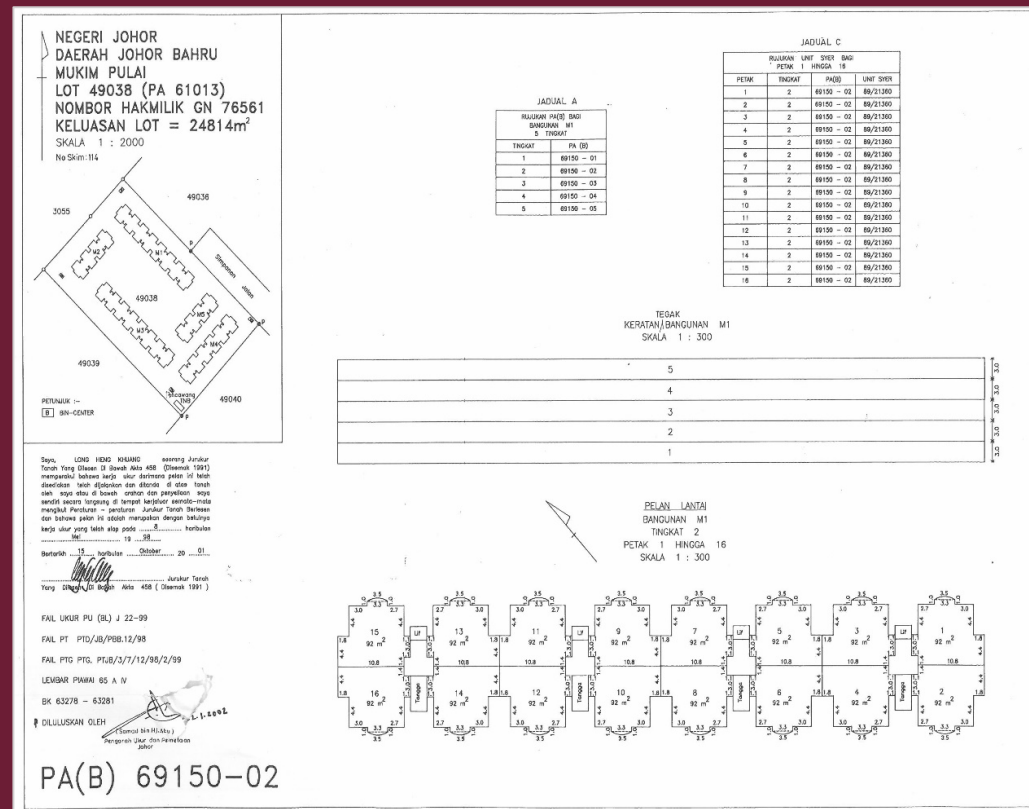
1. Introduction
2. What is strata?
3. Malaysian LADM Country Profile
4. CityJSON – Why?
5. The Experiment
  - 5.1 Architecture Design
  - 5.2 LADM: Spatial and Non–spatial components
  - 5.3 Strata ADE
6. Data Conversion
7. Visualization
8. Conclusion

# Introduction

- Population growth in Malaysia, significant stratified subsurface - densely populated areas, pose a challenge to the current land administration system and the urge to constantly improve.
- This work attempts to **expand the depiction of those strata objects in 3D by implementing CityJSON based encoding.**
- Focus - **visualization of the 3D strata parcels above ground**, CityJSON data format for 3D spatial data modelling, and **to link the 3D Strata Viewer with the database (legal information) of the 3D parcel using a web-based platform**
- Describes the **implementation of the conceptual model of strata objects** based on the **Malaysian LADM Country Profile** for the representation of spatial and non-spatial strata data.

The term 'Strata' was first introduced legally in 1985, as a result of urbanization in major Malaysian cities.

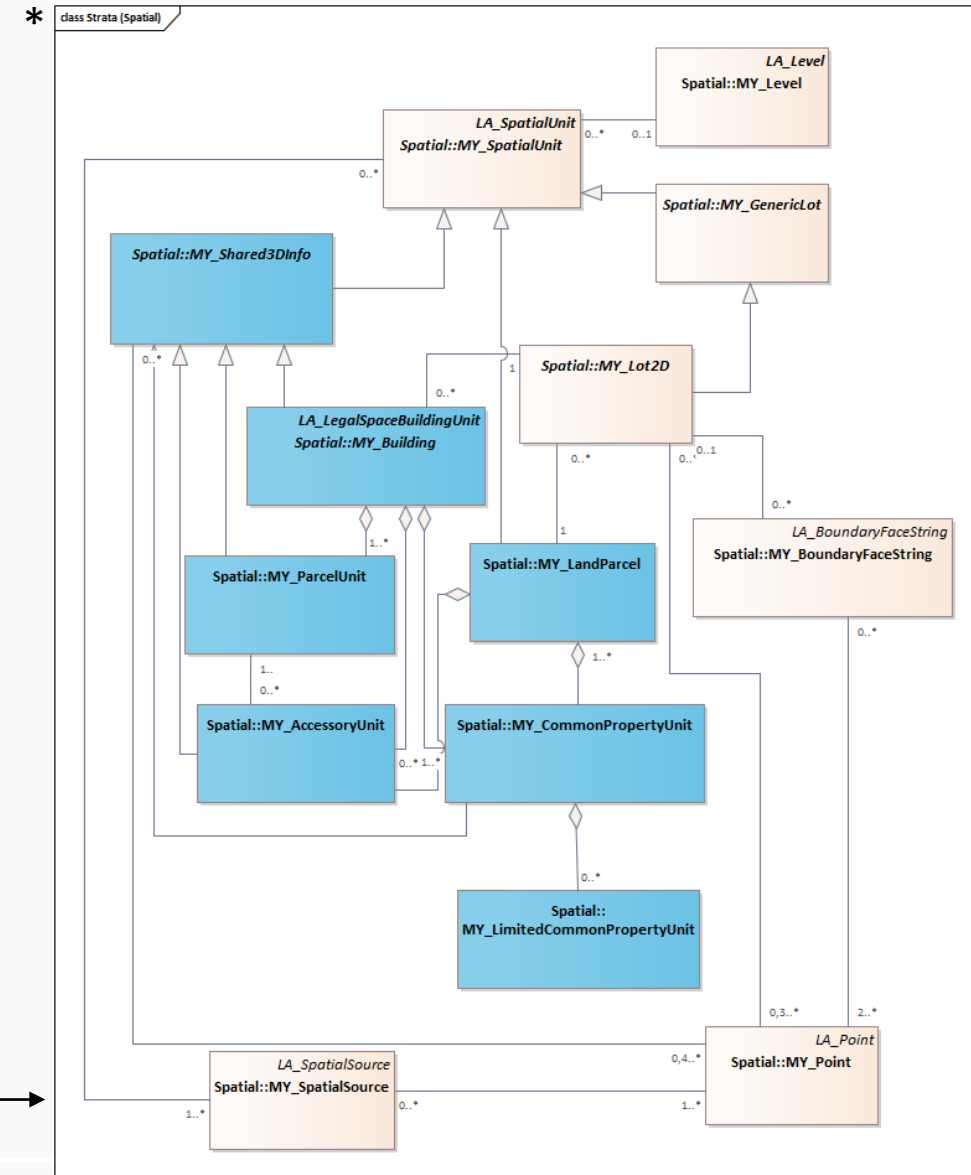
Implementation of Strata Management Act 2013 (SMA 2013), provides clearer provisions for the management of stratified property including residential, commercial, and mixed-use development.



# Malaysian LADM Country Profile

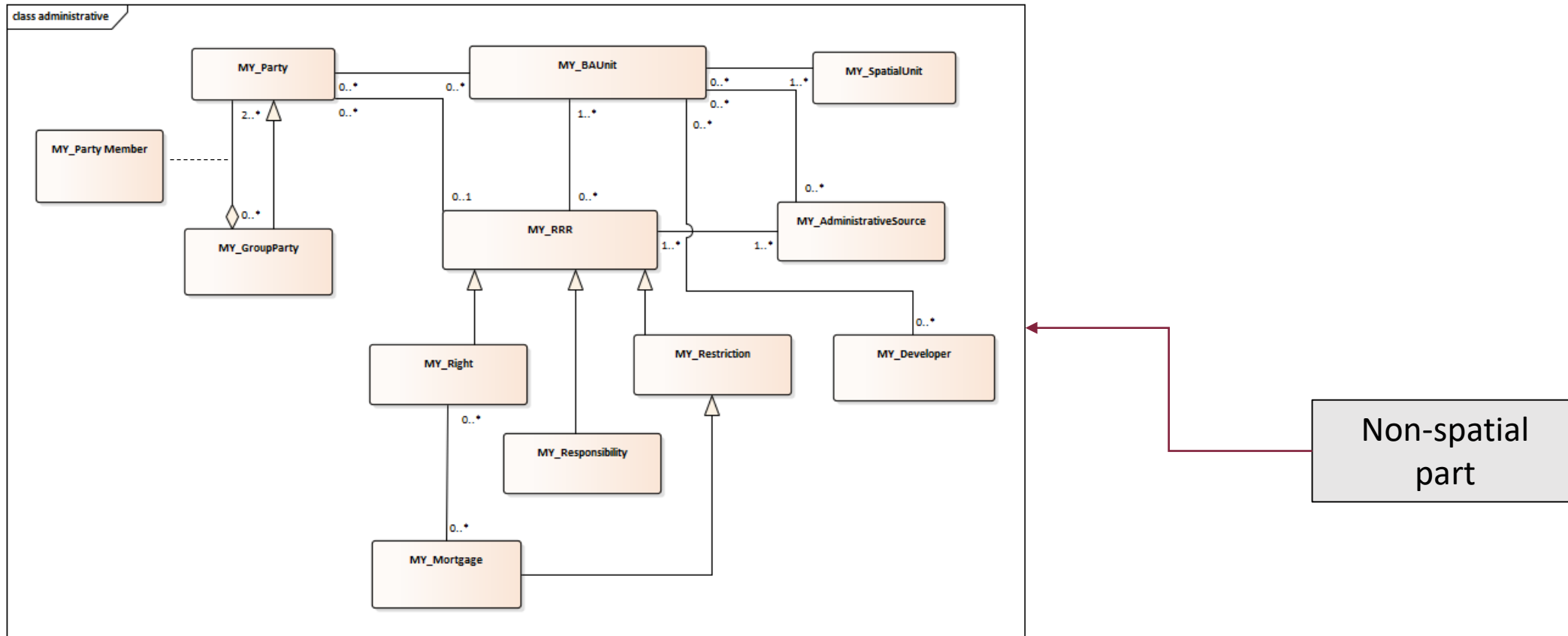
- **Land Administration Domain Model (LADM)** is a standard established by the International Organization for Standardization (ISO) **to cover related components and information of land administration** that include surface above water, land, and elements above and below the Earth's surface.
- One strata object type remains to be represented in 2D, MY\_LandParcel (with building no more than 4 storeys).
- The other strata objects are all proposed to be in 3D.

Spatial part



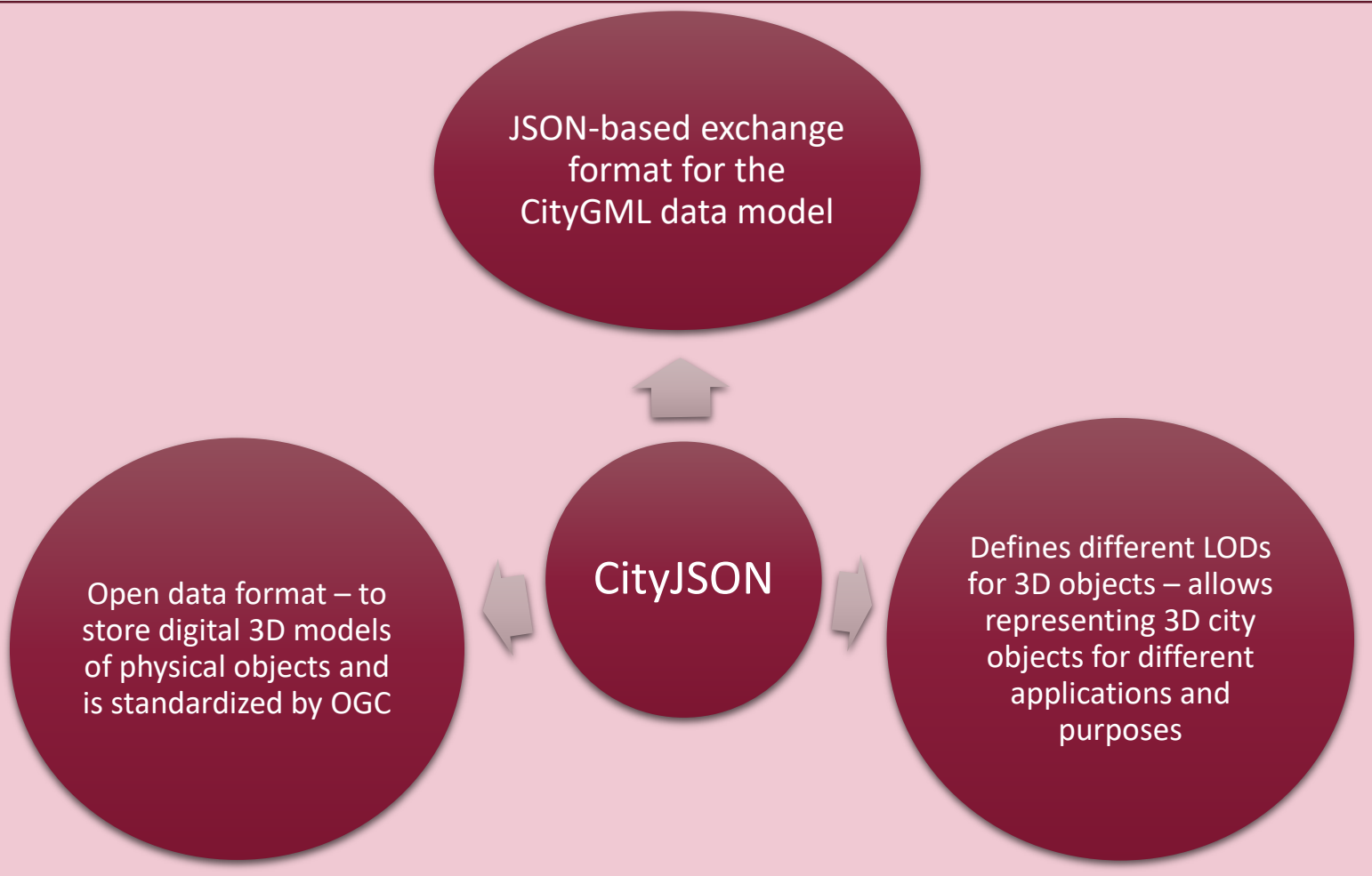
## Design and implementation of 3D strata objects registration based on LADM – A case study in Malaysia

Nur Amalina Zulkifli <sup>a,\*</sup>, Alias Abdul Rahman <sup>a</sup>, Siew Chengxi Bernad <sup>b</sup>



- The non-spatial component consist of object classes used **to represent the legal part in LADM.**
- It consists of the Party and Administrative packages.

# CityJSON – Why?



- Provide support for almost all the features of CityGML, while maintaining a simple file structure, allowing developers to easily manipulate CityJSON files.
- One of the main reasons for CityGML's poor interoperability is the complex and verbose nature of its main encoding, which is based on GML.
- CityJSON is more compact than CityGML, lightweight dataset.

# The Experiment



Architecture Design

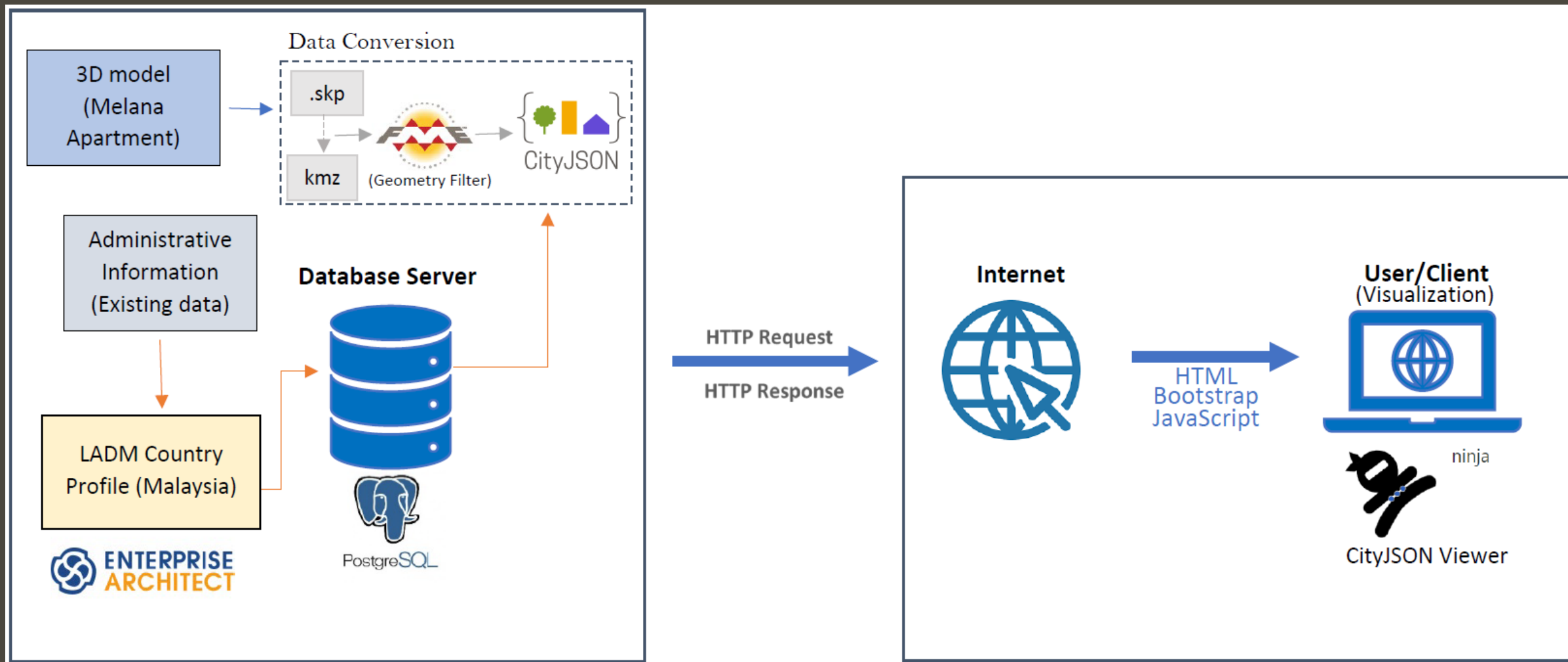
Data model  
- LADM  
- Strata ADE

Data conversion

Visualization



# Web Architecture Design

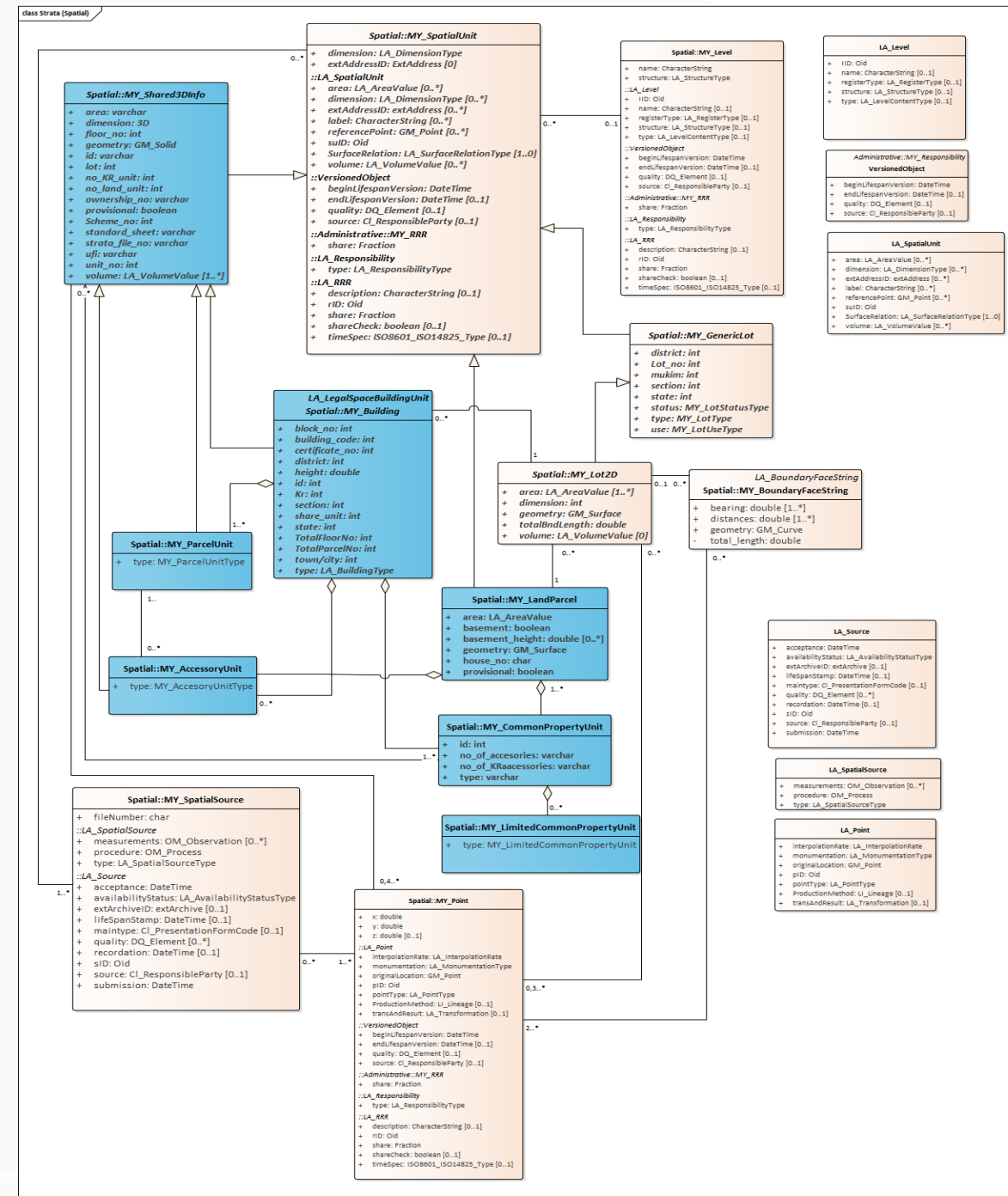




# Conceptual data model (Strata Objects)

## • Spatial component

- The strata objects are all proposed to be in 3D (blue classes).
- Inherit from an abstract class (MY\_Shared3DInfo) with strata specializations (and mutual aggregation relationship) called as MY\_BuildingUnit, MY\_ParcelUnit, MY\_AccessoryUnit, MY\_CommonPropertyUnit, and MY\_LimitedCommonPropertyUnit.



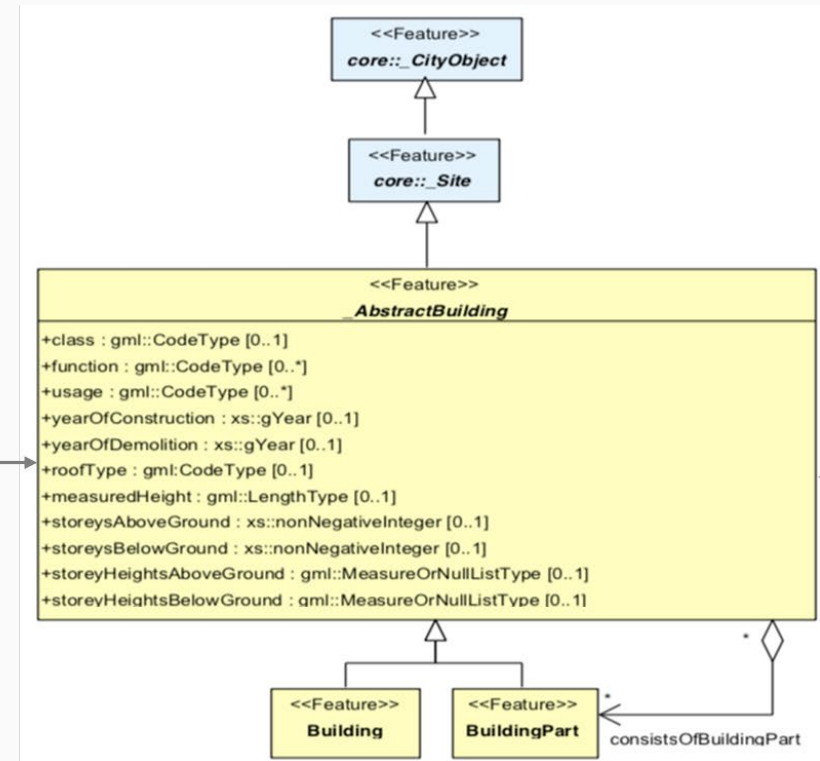
- consists of object classes that are used to represent the legal aspect of LADM.
- It consists of the Party (green classes) and Administrative packages (yellow classes).



CityJSON also support extensions the core data model of CityGML for specific applications and use-cases called ADE's

- The Strata extension is developed to support 3D spatial data modelling, that links with the database (legal information) of the 3D parcel based on LADM Country Profile.
- New attributes added to the Building object based on CityJSON classes.
- The Building object class will have additional attributes (legal information) inherited from the tables MY\_AdministrativeSource and MY\_Shared3DInfo.
- These tables contain legal data related to the administrative (surveyor, party, submission, etc.) and spatial 3D info (area, dimension, floor no, ownership, volume, etc.)

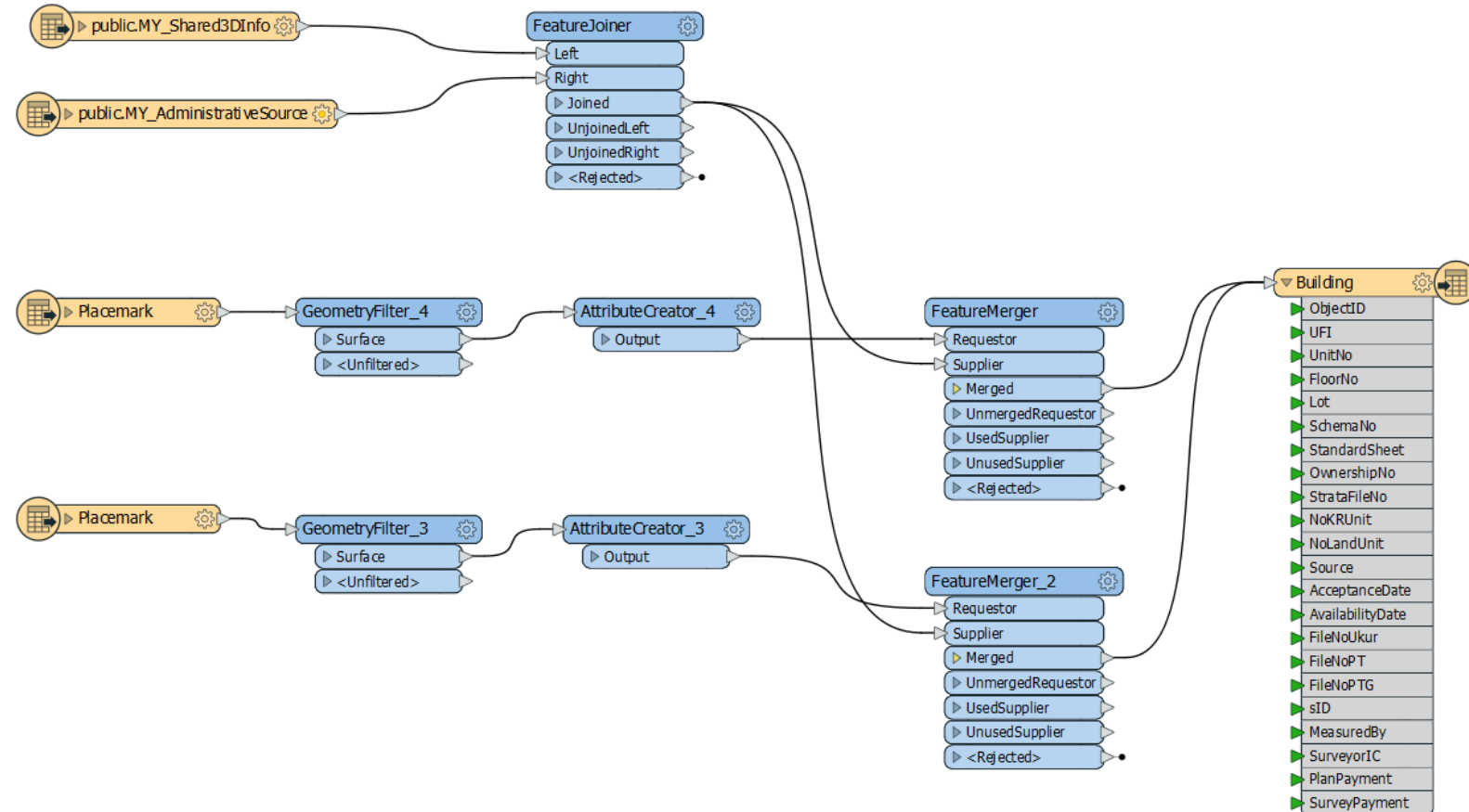
Administrative::MY_AdministrativeSource
+ acceptance_date: date
+ availability_status: text
+ date_of_approval: date
+ file_no_survey: varchar
+ filePt_no: varchar
+ filePTG_no: varchar
+ id: varchar
+ measured_by: text
+ plan_payment: varchar
+ source: text
+ survey_payment: varchar
+ surveyor_ic: varchar
+ ufi: varchar
::LA_AdministrativeSource
+ text: MultiMediaType [0..1]
+ type: LA_AdministrativeSourceType
::LA_Source
+ acceptance: DateTime
+ availabilityStatus: LA_AvailabilityStatusType
+ extArchiveID: extArchive [0..1]
+ lifeSpanStamp: DateTime [0..1]
+ maintype: CL_PresentationFormCode [0..1]
+ quality: DQ_Element [0..*]
+ recordation: DateTime [0..1]
+ sID: Old
+ source: CL_ResponsibleParty [0..1]
+ submission: DateTime



Spatial::MY_Shared3DInfo
+ area: varchar
+ dimension: 3D
+ floor_no: int
+ geometry: GM_Solid
+ id: varchar
+ lot: int
+ no_KR_unit: int
+ no_land_unit: int
+ ownership_no: varchar
+ provisional: boolean
+ Scheme_no: int
+ standard_sheet: varchar
+ strata_file_no: varchar
+ ufi: varchar
+ unit_no: int
+ volume: LA_VolumeValue [1..*]

# Data conversion

- FME provides built-in support to simply read and write data in order to convert it from one format to another.
- Placemark is chosen as the selected feature type as it carries geometry details.
- The administrative information was retrieved from the database by establishing the connection with PostgreSQL.
- Several transformers were used such as the Geometry filter, Feature Joiner, Attribute Creator, and Feature Merger.



# Visualization

- Visualization is done on Ninja for viewing in CityJSON file format on the web application.

## Why Ninja?

- Support MultiSurfaces
- Good for semantic aspect (City model)
- Capacity to display specific information or properties of the objects
- User's ability to access and alter raw CityJSON information.

CityJSON Ninja

ninja.cityjson.org/#

ninja

Objects

City Objects **2 total**

Search for IDs, object type or attributes...

Download Close

U1L2 (LoD2)

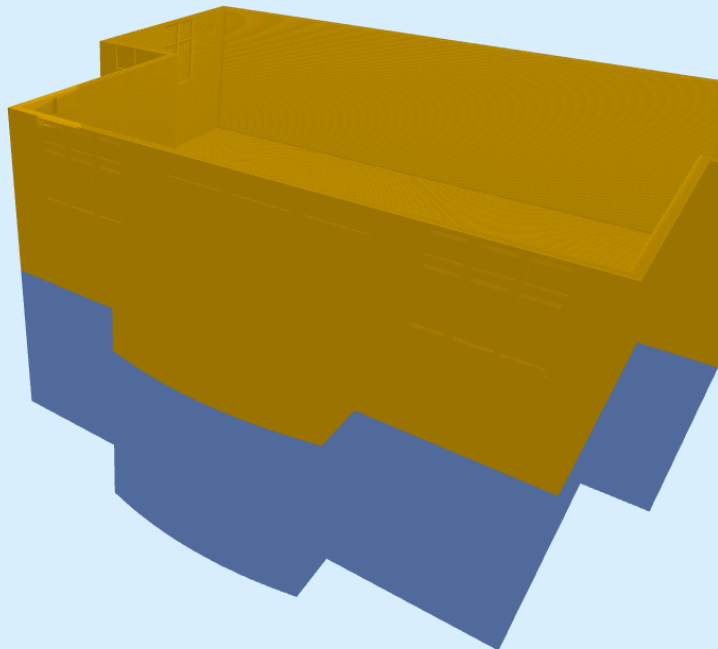
U1L3 (LoD2)

Building

U1L3

22 Attributes 1 Geometries

AcceptanceDate	22/1/2002
AvailabilityDate	Available
FileNoPT	FAIL PT PTD/JB/PBB.12/98
FileNoPTG	FAIL PTG PTG „PTJ8/3/7/12/98/2/99
FileNoUkur	FAIL UKUR PU (BL) J 22-99
FloorNo	3
Lot	49038
MeasuredBy	LONG HENG KHUANG
NoKRUUnit	0
NoLandUnit	5
ObjectID	U1L3
OwnershipNo	GN 76561
PlanPayment	RM20
SchemaNo	114
Source	PTG
StandardSheet	PA1110235
StrataFileNo	PUBLWPB5_2001
SurveyPayment	RM10,000
SurveyorIC	550601-10-5419
UFI	0102030000049038M01003001
UnitNo	17
sID	PA(B) 69150-02



CityJSON

ninja v0.3.0



CityJSON Ninja

ninja.cityjson.org/#

ninja


Objects

City Objects **63 total**

Search for IDs, object type or attributes...

Download Close

- FME-1 LoD2
- FME-10 LoD2
- FME-11 LoD2
- FME-12 LoD2
- FME-13 LoD2
- FME-14 LoD2
- FME-15 LoD2
- FME-16 LoD2
- FME-17 LoD2
- FME-18 LoD2
- FME-19 LoD2
- FME-2 LoD2
- FME-20 LoD2
- FME-21 LoD2
- FME-22 LoD2
- FME-23 LoD2
- FME-24 LoD2
- FME-25 LoD2
- FME-26 LoD2
- FME-27 LoD2
- FME-28 LoD2
- FME-29 LoD2
- FME-3 LoD2
- FME-30 LoD2
- FME-31 LoD2
- FME-32 LoD2
- FME-33 LoD2
- FME-34 LoD2
- FME-35 LoD2
- FME-36 LoD2



CityJSON  
ninja v0.3.0



# Thank you