

Yangon Urban Development Management Project -Implementation of Building Survey and Mapping in Yangon by Utilization of ArcGIS Online-

ヤンゴン都市開発管理プロジェクト

－「ARCGIS ONLINE」を用いた既存建物調査および地図作成の実施－

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都市開発の管理能力の向上を目的とした「ヤンゴン都市開発管理プロジェクト」が独立行政法人 国際協力機構（JICA）によって実施された。本調査では、今後のゾーニング規制および建築許可の検討に資するため、既存建物調査の実施および建物利用現況図の作成が行われた。本稿では、ミャンマーの最大都市のヤンゴンで実施した本格的かつ大規模な都市計画に関する調査方法と品質管理の方法を中心に紹介する。本調査では 42 のスタッフを雇用し、ArcGIS Online を活用することで、8 ヶ月間でヤンゴン市における約 97 万戸の建物現地調査を実現させた。

Keywords : ArcGIS Online、既存建物調査、ゾーニング規制、建築許可

1. INTRODUCTION

Yangon City, the former capital of the Republic of the Union of Myanmar, has a population of approximately 5.5 million (in 2014). As the largest industrial and commercial city in Myanmar, the population in Yangon increase rapidly. The future population of Yangon is estimated to be 10.8 million in 2040, with average population growth rate of 2.6%. Various tasks and actions need to be taken to manage current rapid urbanization as it puts more pressure on existing infrastructure. Using population data in 2014 as the basis data, Fig.1 shows population forecast in Yangon until 2050.

Yangon is also undergoing of rapid transformations which are visible in the increasing of demand for urban development projects by private enterprises. As a result, massive changes in urban development occurred in Yangon city center and several large-scale developments was proposed in suburb areas.

On the other hand, in the period of this rapid development, currently Yangon has no precise rule and regulation for

zoning and building permit as one of framework for urban development in Yangon. Absence of zoning regulation indicates that Yangon does not have the formal land use strategy. To guide and control the development of Yangon, the city master plan and a precise zoning regulation are needed. For this reason, the Yangon Regional Government (YRG) and Yangon City Development Committee (YCDC) want to provide the city with clear urban planning rules and regulations. Although YCDC made a draft of zoning regulation in 2013, it has not been approved due to the subsequent changes of government and it has not been formally introduced.

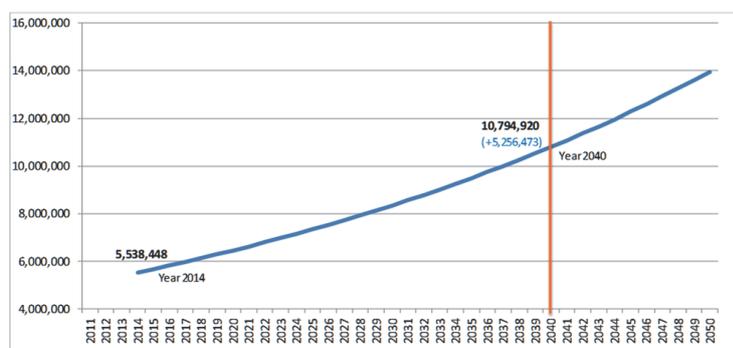


Fig.1 Population Forecast in Yangon¹⁾

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2. THE PROJECT OUTLINE

In the context of management of Yangon city development, Japan International Cooperation Agency (JICA) supported formulation of “The Project for the Strategic Urban Development Plan of the Greater Yangon” (SUDP) in 2013 and the “Yangon Urban Transportation Master Plan” (YUTRA) in 2014. These plans aim to solve current urban problem and anticipate longer-term challenges. As the city grows rapidly, demand of urban development projects has increased. The dense new buildings create uncomfortable condition for the neighborhoods. In response to these, the new administration of Myanmar, established in April 2016, strongly recognized that revision on urban structure plan is necessary. Based on this matter, JICA conducted surveys on updating these master plans (“SUDP review survey” and “YUTRA review survey”) from July 2016 to December 2016.

To implement these master plans, The Yangon Regional Government (YRG) and Yangon City Development Committee (YCDC) requested JICA through “Yangon Urban Development Management Project” (YUDM) to improve urban development management capacity and establish zoning regulation for the city.

Based on the project purpose, there are 2 main works of consultant team in YUDM: 1) conducting existing building survey and 2) providing existing building information map. These outputs will become instruments to formulate and analyse zoning regulation in Yangon. Understanding the building information is essential to support urban development and management in various aspects such as determining zoning regulation, deciding reserve land for future development, helping on defining applicable regulation to each land plot, etc.

The building survey in YUDM is targeted for the whole Yangon area under YCDC jurisdiction scope inside the outer ring road, with has approximately 700km² area. The target area is all buildings inside the red line boundary in the following map (See Fig.2).

In the “SUDP review survey”, the consultant team conducted building information survey in some pilot townships in Yangon. Target survey item in this survey was floor number and building use. This survey used a conventional field survey method by visiting the field and inputting the building information into a paper-based map. One surveyor was able to input building information around 100-110 polygons per day. After inputting the information, following by inputting the data into GIS. Averagely one GIS operator was able to input 150 polygons per day.

Using a conventional field survey method is the simplest

method and requires less expertise. However, considering this project will conduct building survey in a large coverage area, using this method requires a huge number of human resources and long process to collect the data. Therefore, a more convenient method for the data collection is important. It was intention of the consultant team to complete the works within the given time period.

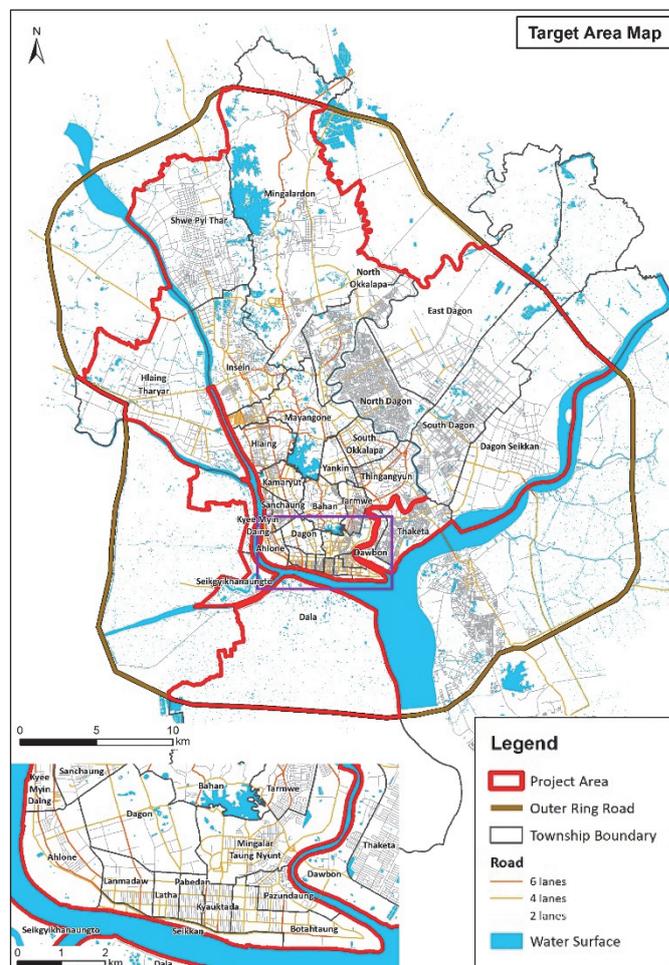


Fig.2 Field Survey Target Area Map

The major challenges of these works are enumerated as follow:

1. How to complete the field survey for 967,454 number of buildings in eight months period to collect building use, building structure, car parking availability and floor number.
2. How to conduct an effective survey, manage and maintain the data quality with available 42 surveyors in the site. These surveyors are collaboration of 10 persons from the counterpart side which have experiences on the conventional building survey method, and 32 fresh graduate persons from the consultant team side which are un-experienced on conducting building survey.

To overcome these challenges, the consultant team decided to carry out the field survey with a more suitable method rather than conventional field survey method. This article will introduce a practical application in the field survey by using ArcGIS online installed in mobile phone for collecting building information in Yangon, which was carried out for preparation of zoning regulation formulation, under technical cooperation project of JICA. By using this method, some steps in the conventional method can be done in the same time. As a result, it could reduce time and human resources. Comparison of these methods is shown in Table 1.

Table 1 Comparison of Conventional and ArcGIS Online Method

Comparison Items	Conventional	ArcGIS Online
Equipment	<ul style="list-style-type: none"> • Camera. • Paper-based map. 	<ul style="list-style-type: none"> • Camera. • Mobile phone with ArcGIS Collector.
Field Survey	<ul style="list-style-type: none"> • Camera automatically take picture in 5 seconds period. • Inputting only floor number in paper-based map. 	<ul style="list-style-type: none"> • Camera automatically take picture in 5 seconds period. • Inputting building use, floor number, building structure and car parking availability in mobile phone.
Desk Survey	<ul style="list-style-type: none"> • Inputting building use in paper-based map by checking the photo from field survey. • Inputting all recorded data in paper-based map into GIS (shape file). 	<ul style="list-style-type: none"> • Downloading field survey data (shape file) from ArcGIS Online.
Working Time	<ul style="list-style-type: none"> • Field survey inputting data: 100-110 buildings/day/person. • GIS inputting data: 150 buildings/day/person. 	<ul style="list-style-type: none"> • Field survey inputting data and GIS inputting data simultaneously: 150-200 buildings/day/person.
Human Resources	<ul style="list-style-type: none"> • Training on survey method is not necessary. • 1 person for inputting floor number on site, 1 surveyor for inputting building use at office and 1 GIS operator to input the data are needed. 	<ul style="list-style-type: none"> • Training on survey method is necessary. • 1 person to input all information on site and 1 GIS operator to download the data are needed.

Accuracy		
	<ul style="list-style-type: none"> • There is possibility of inputting wrong photo information in wrong target building. • Difficult to recognize the building for checking the accuracy. 	<ul style="list-style-type: none"> • Mobile phone has GPS that helps easily identify the target building on site. • Easy to recognize the target building location for checking the accuracy.

The detail method and advantages of using ArcGIS online in the survey are explained in the following sessions.

3. THE WORK ITEM'S SURVEY METHOD

The whole works in this project are carried out with two methods namely field survey and desk survey. Data to be collected for each survey method is shown in Table 2.

Table 2 Field and Desk Survey Item

Item/Data	Method	Purpose
(1) Building Use	Field	Building use regulation
(2) Structure	Field	Fire prevention area regulation
(3) Car Parking	Field	Parking lot regulation
(4) Floor Number	Field/Desk	Floor area ratio regulation, height regulation
(5) Building Area	Desk	Floor area ratio regulation, building coverage ratio regulation
(6) Total Floor Area	Desk	Floor area ratio regulation
(7) Site Area	Desk	Minimum site area regulation
(8) Heritage Building	Desk	Building conservation
(9) Road Connection	Desk	Road connection regulation
(10) Setback	Desk	Building setback regulation

The field survey was combination of on car and on walk survey. It used ArcGIS online in mobile phone to input required information. From the next part, this article will focus on detail explanation only about the field survey method.

4. EXISTING BUILDING SURVEY IMPLEMENTATION AND MANAGEMENT

(1) FIELD SURVEY ITEM

1) Building Use

Building use is categorized based on basic urban planning survey in Japan and adjusted based on the situation in Yangon through discussions with the counterpart and JICA Long-term Experts. Before starting the field survey in September 2018, the consultant team divided building use into 20 categories and 30 sub-categories. But, based

on condition in the field, some buildings are covered by high fence or trees that caused difficulty in confirming the building information. Based on this fact, in October 2018, one category – “21. cannot see/cannot enter” was added. The number of category/sub-category is 51 in total. Appendix 1 shows category and sub-category of building use and example for each category.

2) Building Structure

Building structure is categorized based on SUDP and census. The consultant team classified the building structure into four categories (1) Reinforces Concrete (RC), Steel (S), or Steel-Reinforced Concrete (SRC), (2) wood, (3) bamboo, (4) others (temporary construction, building that cannot be determined).

3) Car Parking

The consultant team classified two categories for car parking, existence of parking lot (1) can be identified and (2) cannot be identified inside a building.

4) Floor Number

Original plan on inputting floor number information was through field survey and desk survey. In the implementation the consultant team was able to input actual floor number during field survey for almost whole target areas. However, floor number of some buildings that surveyor could not access on site were calculated by height of the buildings from GIS data.

(2) UTILIZATION OF ARCGIS ONLINE IN FIELD SURVEY AND DATA MANAGEMENT

1) How It Works

ArcGIS online is a cloud-based mapping platform licensed through Environmental Systems Research Institute (ESRI). It allows registered organization user to create, store, analyze and share geographic information. After subscribed a license, the consultant team set survey map and install collector for ArcGIS in mobile phone. The mobile phone is also installed with map and GPS integration. Fig.3 shows the process of ArcGIS online setup. In this project, the consultant team subscribed for 42 user accounts.

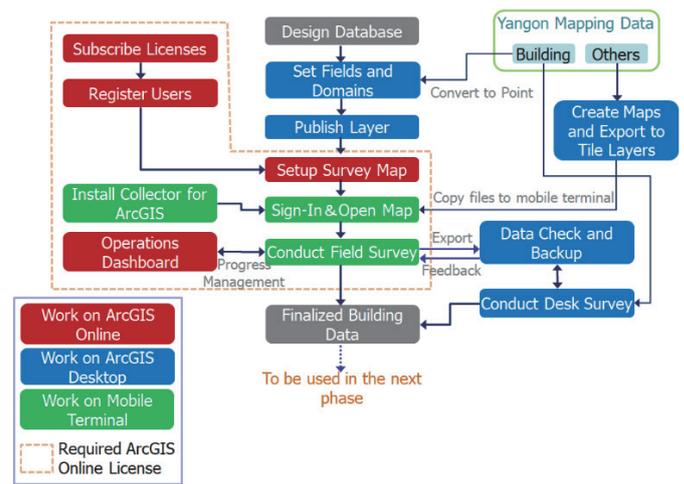


Fig.3 shows the ArcGIS Online Set-up Flow Chart

Surveyor will input information for each item (building use, structure, car parking availability, and floor number) for every building. Field data information will be inputted to mobile phone by choosing or clicking a point (represent a building) in the mobile phone’s map. As the mobile phone equipped with GPS system, the surveyor is able to recognize the building to be surveyed in the field.

When inputting the building information, surveyor needs to click the point in the map. After clicked the point, all data input screen will appear. The surveyor simply clicks each item (building usage, structure, car parking and floor number) and input the information. Data input is design by pull-down menu choices for an easy and quick process. Fig.4 shows data input and pull-down menu screen in the mobile phone.

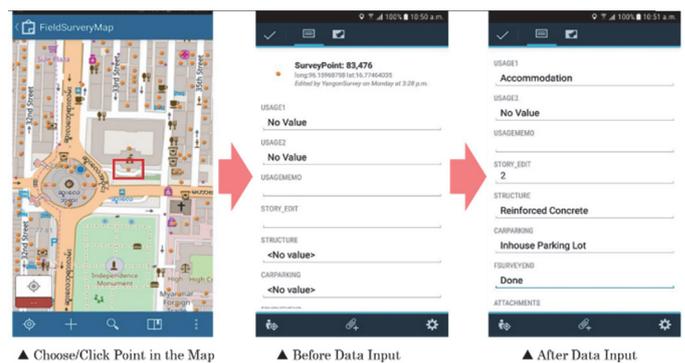


Fig.4 Example of ArcGIS Online Collector Data Input Screen

The point in the map has two colors, blue indicates not yet surveyed building and orange for already surveyed building (see Fig.5). After all information are inputted, the point color on the map will automatically change from blue to orange. The color indicator will minimize possibility of double input information in the target building.

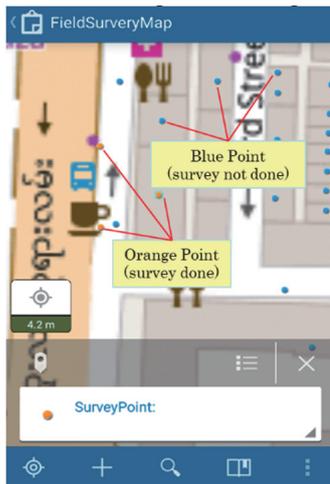


Fig.5 Example of ArcGIS Building Color Indicator in ArcGIS Online Collector

The map with all inputted information shows in mobile phone can be shown in ArcGIS dashboard in computer (See Fig.6). Once information in mobile phone was updated, the information in computer will also be updated in the same time.

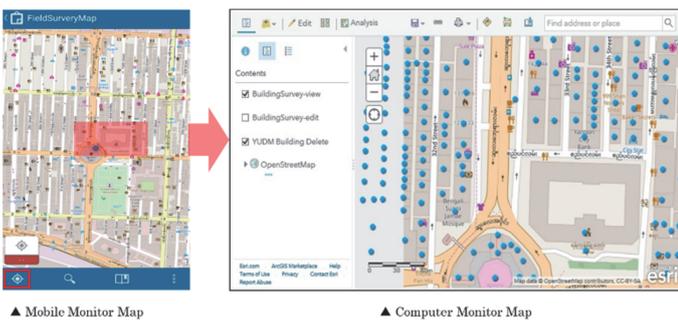


Fig.6 ArcGIS Online Dashboard in Computer

All inputted information gathered from field survey will automatically be stored in secure ESRI cloud, and desk survey team (GIS operators) can monitor and confirm the information in a real time. The field survey data from ArcGIS online can be exported in various formats including shapefile. It improves the work efficiency in collecting the field data and inputting the GIS data simultaneously. Fig.7 shows simultaneous data input and data update in ArcGIS collector in mobile phone and ArcGIS online in computer.

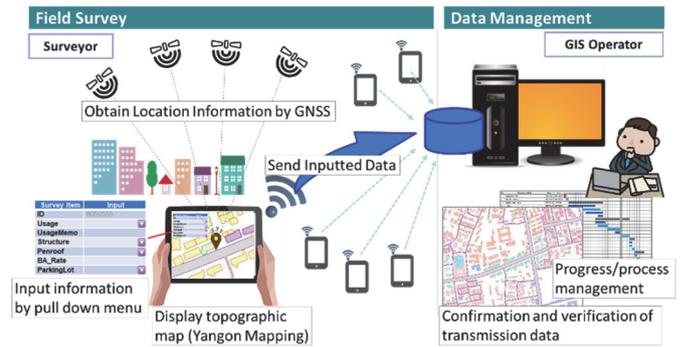


Fig.7 Data Input in Field Survey and Data Management

The mobile phone may not work effectively depending on the season or survey environment. During summer, the outside temperature may affect the mobile phone, the battery will become hot easily. And, in some outskirt areas where the internet connection is low, the collector loading time will be longer than usual. But, gathered data can be temporarily stored on the device and then easily uploaded when internet service is available. To respond this possibility other methods such as paper-based as a back-up also used in this project.

2) Prior to the Field Survey

Planning ahead is important for an adequate and successful field data collection. Different from conventional field survey method, conducting building survey using ArcGIS online requires specific knowledge on the operation. In this project, the consultant team held an orientation, training and trial survey for survey managers (3 persons), surveyors (42 persons) and GIS operators (5 persons) before the project started. All of them had never been experienced using ArcGIS online before. Photo 1 and Photo 2 show project orientation and training activities.

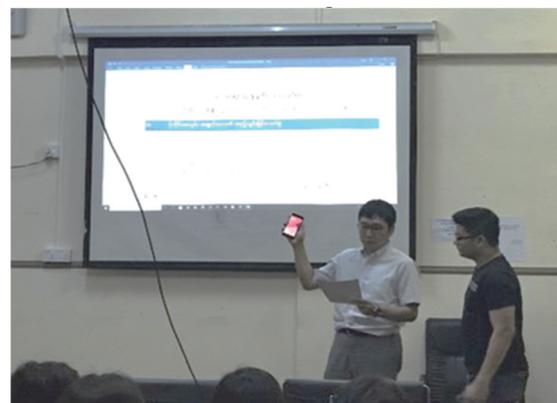


Photo 1 Consultant Team Explained the Field Survey Method



Photo 2 Survey Managers, GIS Operators and Surveyors Attended the Orientation and Training

Orientation and training are an important step to ensure accurate and reliable data are collected and all team members work well in the field. A well-trained team is critical in producing reliable survey results. The two weeks training included explanation of attribute data (survey item) to be collected, a detailed tutorial outlining how to set and use the survey equipment, how to input the data into mobile phone and how to analyze the data on desk survey works. Step by step instructions and corresponding discussions helped the participants easily follow the training.

At the end, surveyors conducted survey trial to get used to with the survey method and test the method as final review of the process for the consultant team before the real survey. Once surveyors have familiarized with the tools available in the mobile collector, they can begin collecting data smoothly. Photo 3 shows on walk trial survey conducted by surveyors.



Photo 3 Surveyors Inputted Building Information in a Trial Survey

3) The Field Survey Implementation

The field survey was conducted on Monday to Friday, from 09:30-16:30. Total 21 teams (2 persons/team) conducted survey in the whole 33 target townships. The field survey mainly performed inside a car. Two surveyors in a team inputting building usage, building structure, parking lot and floor number into mobile phone for every building passed by

the car in the right and left side of a road (See Photo 4).



Photo 4 Two Surveyors Conducted Survey in a Car

In addition, on the car dashboard there were two cameras which take photo periodically on left and right side of the road during the survey (See Photo 5). Photo from the camera is a backup for the building information confirmation if it is needed.



Photo 5 Two Cameras Setting in a Car Dashboard

Due to the area condition such as narrow road and building that is covered by big trees, the surveyors need to do the survey by walking along the street and input the building information to mobile phone (See Photo 6).



Photo 6 Surveyors Conducted Survey on Walk

Normally one surveyor can input around 150-200 buildings/day. Number of inputted buildings depended on the internet connection and the area condition such as, distribution of the building’s location, traffic condition and slum areas. Progress of inputted data can be monitored from the operation dashboard of ArcGIS online. Fig.8 shows field survey operation dashboard to monitor each surveyor’s daily progress.



Fig.8 Daily Field Survey Progress in the Operation Dashboard

4) Field Survey Data Management Meeting

For the data quality management, survey managers, surveyors and GIS operators held a periodically meeting at the project’s office. The purpose of this meeting is to review the work carried out in the field and ensure data quality of the survey results.

42 surveyors which consisting of 21 teams are divided into 5 groups (1 group is consisting of 4-5 teams). Every day different group will have meeting from 09:30-12:00 to report their progress and issues in the field survey implementation. After the meeting, surveyors will continue to conduct the field survey. Fig.9 shows each group’s schedule meeting. The quality check meeting schedule is as follow:

- Group A: every Monday
- Group B: every Tuesday
- Group C: every Wednesday
- Group D: every Thursday
- Group E: every Friday

Group	Team	Week Plan													
		Mon AM	Mon PM	Tue AM	Tue PM	Wed AM	Wed PM	Thu AM	Thu PM	Fri AM	Fri PM				
Group A	Team 1-4	Meeting @office													
Group B	Team 5-8			Meeting @office											
Group C	Team 9-12					Meeting @office									
Group D	Team 13-16								Meeting @office						
Group E	Team 17-21											Meeting @office		Field	

Fig.9 Groups and Quality Check Meeting Schedule

During the meeting, GIS operators report if any data entry errors were made or other data quality issues found out. If error was identified, GIS operators and the surveyor will work together, and revise entered information directly. Photo 7 shows the meeting activity at office.



Photo 7 Daily Meeting with Surveyors

5. THE FIELD SURVEY RESULTS AND DISCUSSIONS

(1) THE FIELD SURVEY RESULTS

The main advantage of using ArcGIS online in the field survey for building information in this project is saving time and human resources. If this was carried out by conventional method, the time and resources needed would be much higher. The counterpart enthusiastic about their ability to collect a lot of data in easy and effective way and in a short period of time.

The consultant team was able to collect: 1) building use; 2) building structure; 3) car parking availability; and 4) floor number information in the field survey. Each category results are presented in Fig.10–Fig.17 below.

1) Building Use

Building use information is important in formulating zoning regulation to define the zones based on type of uses. Nearly two third of buildings in YCDC area is residence use. This is in line with the population growth happens in Yangon every year.

2) Building Structure

Building structure information in this project will become a basis for fire prevention area regulation. Based on the survey result, 37.3% or less than half of total buildings in Yangon are made of Reinforced Concrete (RC), Steel (S), or Steel-Reinforced Concrete (SRC). These category is agglomerated in some townships around the city center.

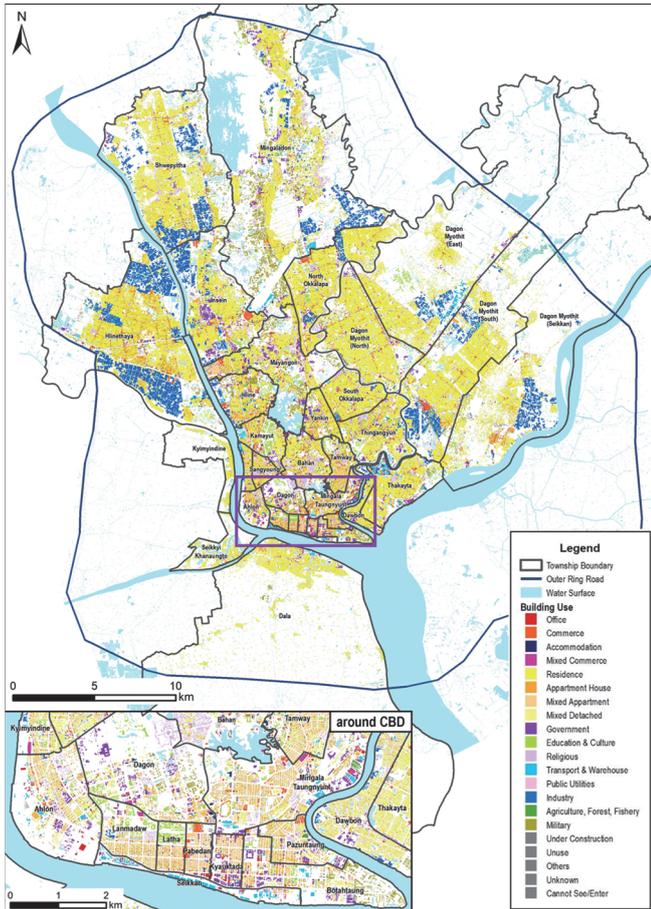


Fig.10 Building Use Map in Yangon

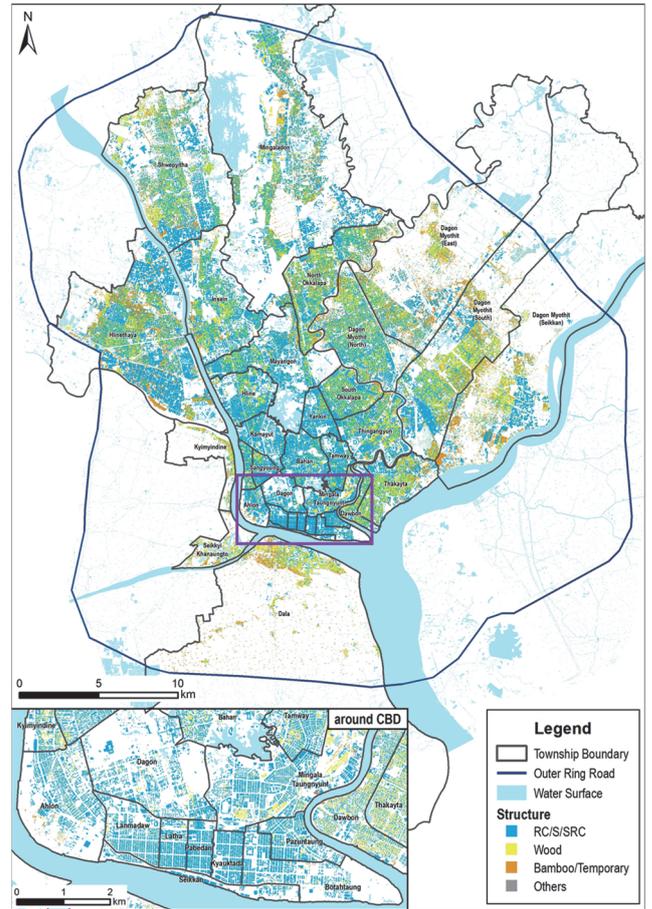


Fig.12 Building Structure Map in Yangon

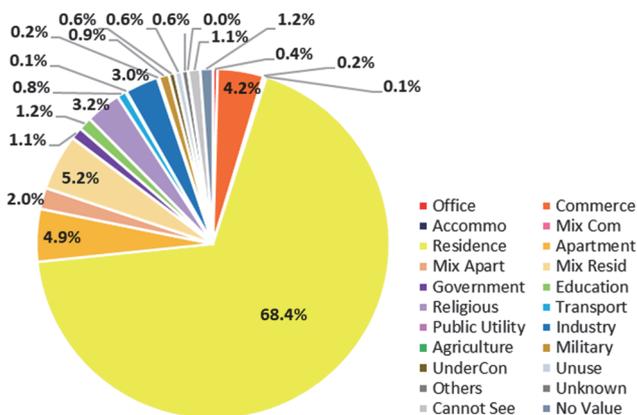


Fig.11 Building Use Rate in Yangon

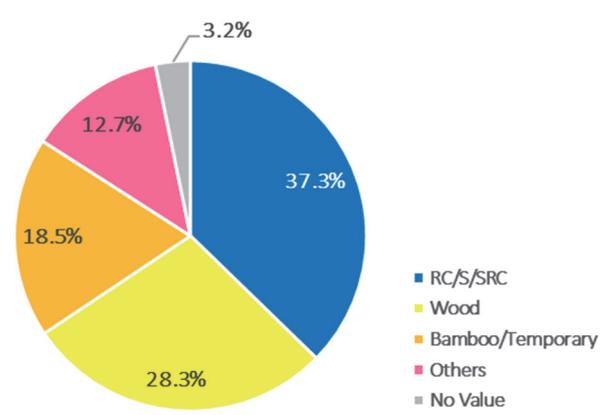


Fig.13 Building Structure Rate in Yangon

3) Car Parking

Car parking information in this survey is collected for parking availability inside a building. Currently only 0.46% buildings are identified to have car parking and this number is very small considering number of buildings and development growth in Yangon. This parking is not concentrated in CBD area, due to most of buildings in CBD area have outdoor parking and parking on road. Buildings that have parking inside are mostly shopping mall, accommodation and apartment.

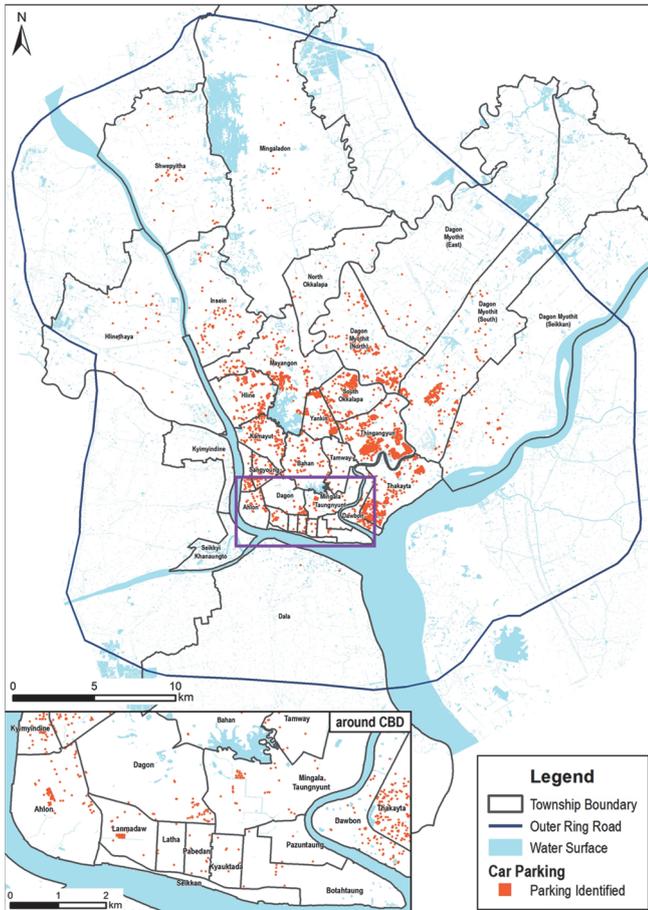


Fig.14 Car Parking Availability Map in Yangon

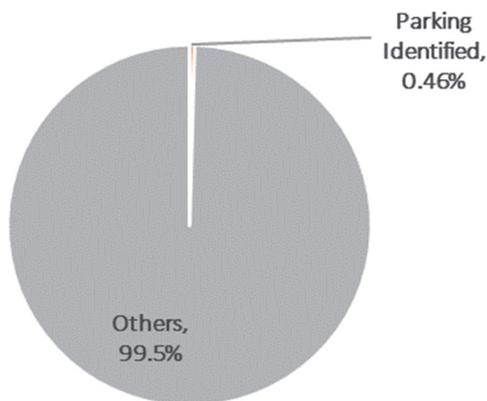


Fig.15 Car Parking Availability Rate in Yangon

4) Floor Number

Floor number information in this project is important for floor area ratio regulation and height regulation. Currently high-rise buildings are concentrated in CBD area.

In CBD area, Shwedagon Pagoda Restricted Areas and Heritage Conservation Areas are used as the important base to set up the building height regulation in Yangon.

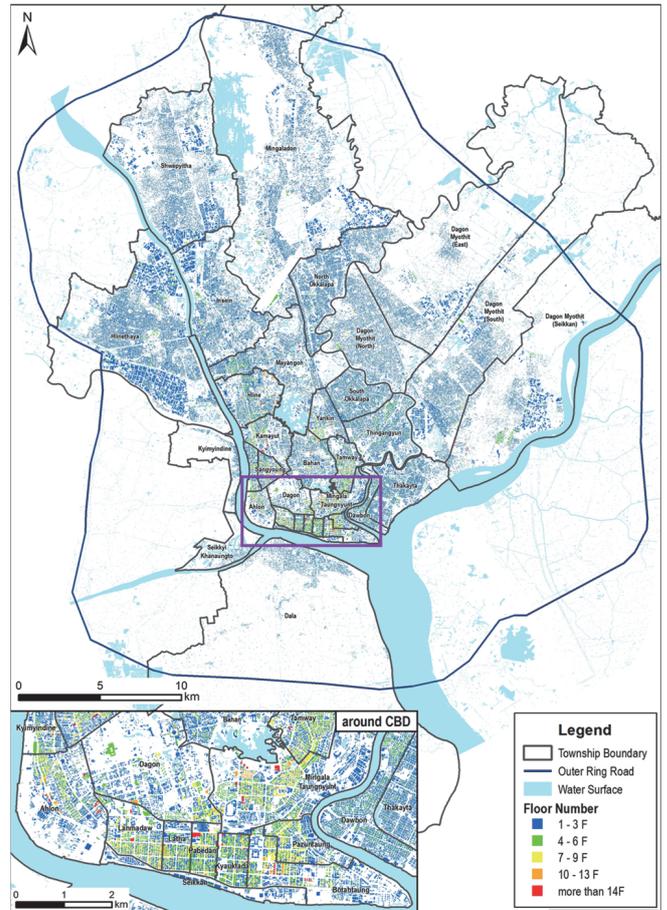


Fig.16 Building Floor Number Map in Yangon

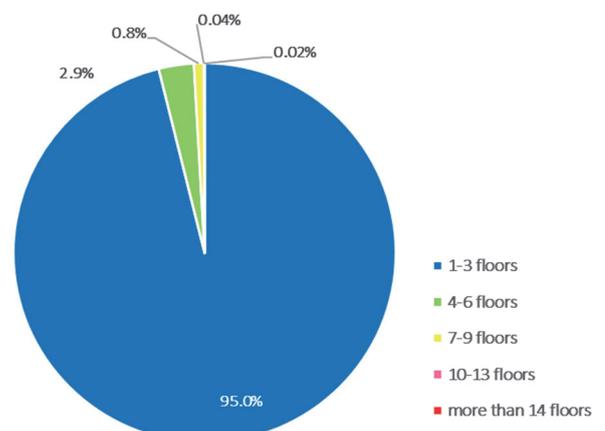


Fig.17 Building Floor Number Rate in Yangon

(2) DISCUSSIONS

This part will discuss two aspects on implementing ArcGIS Online for the building information survey in Yangon City.

1) Advantage and Disadvantage of ArcGIS Online

Despite the successful of the project, using this method has several advantages and disadvantages. Utilizing ArcGIS online in this project has the following advantages:

1. Able to save a lot of human resources and time;
In conventional survey, inputting building information data is conducted twice. Floor number is inputted on site and building use is inputted at office by checking the photo. While using ArcGIS online, one surveyor able to do these works in the same time on site.
2. Surveyor can easily locate the building location;
Mobile phone is equipped with GPS that helps surveyor on identifying the target building on site.
3. Surveyors can edit survey data anytime (if necessary);
Editing data can be done both in mobile phone and ArcGIS desktop and the editing record also can be confirmed.
4. Field survey and GIS data input are conducted simultaneously;
As mentioned in “2. Project Outline” session, two steps in conventional survey (inputting building information on site and inputting data into GIS) can be done in one step by using ArcGIS online.
5. Easy to monitor the survey progress;
This system has progress chart indicator that recorded daily activity of the surveyor.
6. Easy to change the survey map or layers.
Changing the base map will not affect previously inputted data.

However, there are also disadvantages of this method found in this project, such as the following:

1. Initial cost for the ArcGIS online subscription is expensive;
Initial subscription cost as of August 2018 is 100,000 JPY.
2. License for each user/surveyor is needed and the license is expensive;
One license for one mobile phone cost as of August 2018 is 80,000 JPY. This project purchased 42 licenses.
3. Mobile phone/device and internet connection for each user/surveyor is needed.
4. In some areas, the internet connection is unstable, it caused delay on field survey data input.

2) General Finding Based on Project Experiences

During the field survey it was observed that due to safety reason, slum areas were difficult to be surveyed. The residence in the slum areas tend to reject the survey activities. In this project, the consultant team requested YCDC to issue official letter and the township officer accompanied the surveyor in the field.

Apart from the safety issue, problem on identifying the building information also encountered for building that covered by high fence or tree. For this case, the surveyors inputted information as much as possible in the field and write memo for unobtained information. The information that cannot be obtained was mostly the floor number. In this project, the consultant team calculate the floor number in desk survey based on the building height information from GIS data.

Each target area has their own uniqueness. To minimize the delay on the work process, it is important to predict problems that might occurred and prepare the countermeasure to overcome the problem.

6. CONCLUSION

The consultant team proposed a field survey method using ArcGIS online installed in mobile phone to collect existing building information in Yangon. With this method, the consultant team was able to input 967,454 number of building information in 33 target townships. To complete this work, 42 surveyors in total collected information during the field survey from Monday to Friday. Each surveyor was able to input 150-200 buildings per day averagely. With this number, the field survey was completed in eight months (September 2018 – April 2019).

Besides completion of existing building survey and provision of building information maps, this project also provided field and desk survey works manual. The field survey manuals contained technical information on how to set and operate the survey equipment and step by step on data input method. The desk survey manuals are more technical for using and analysing various data in GIS. All manuals are compiled systematically, the counterpart can follow the work procedures easily for updating the data in the future.

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APPENDIX 1

Table Building Use Category and Sub-Category in Yangon

Category		Sub-Category		Note/Examples
1	Office	-	-	Office, Bank, Meeting hall, Conference hall/ Convention center/ Concert hall, Private research institute, Money exchange, etc.
2	Commerce	2-1	Store	Department store, Retail store/ Drug store, Wholesale store, Media corner, etc.
		2-2	Restaurant	Restaurant/ Banquet hall, Café, Delivery food, etc.
		2-3	Service	Beauty salon (parlour), Barber, Lesson school/ Vocational training centre, Private cram school for university entrance examination, Home exhibition centre, Media studio, Art gallery, Veterinary, Car wash, Laundry, Motor vehicle showroom, Print shop, Other service facilities
		2-4	Night Entertainment	Karaoke box, Night club/ Dance hall, Bar, etc.
		2-5	Private Theatre	Theatre, Movie theatre, etc.
		2-6	Sports and Game	Bowling alley, Golf range, Fitness centre, Internet café/ Game center/ Amusement arcade/ Billiard, etc.
		2-7	Petrol Station	Filling station (petrol station), etc
		2-8	Public Market	Wholesale market (public), etc.
3	Accommodation	-	-	Hotel, Inn, Tourist home, etc.
4	Mixed Commerce	-	-	Above <u>1 to 3 mix use</u> and major floor use area is less than 3/4 of total floor area
5	Residence	-	-	Detach house including storeroom and garage
6	Apartment House	-	-	Apartment/ Dormitory, Condominium, Public officer house, Service apartment, etc.
7	Residential Mixes Apartment House			Above <u>'6' apartment house and 1 to 4, 9, 10, 14 mix use</u> * Residential use is more than 1/3 of total area
		7-1	Office	Above '1' Office
		7-2	Store	Above '2-1' Store
		7-3	Reastaurant	Above '2-2' Restaurant
		7-4	Service	Above '2-3' Service
		7-5	Night Entertainment	Above '2-4' Night Entertainment
		7-6	Industry	Below '14' Industry
		7-7	Government	Below '9' Government
		7-8	Others	Others
8	Residential Mixed Detached House			Above <u>'5' Residence and 1 to 4, 9, 10, 14 mix use</u> * Residential use is more than 1/3 of total area
		8-1	Office	Above '1' Office
		8-2	Commerce	Above '2' Commerce
		8-3	Industry	Below '14' Industry
		8-4	Others	Others
9	Government	-	-	Central government office, Local govenrnt office, Courthouse, Tax office, Police staion, Fire station, Post office, Embassy, Jail, etc.
10	Education and Culture	10-1	Public University	University, College, Technical college, Public research institute, etc.
		10-2	Private University	University, College, Technical college, etc.
		10-3	Public School	Primary/Secondary/High school, Nursery, Kindergarten, etc.

Category		Sub-Category		Note/Examples
		10-4	Private School	
		10-5	Public Culture Facility	Library, Museum, Public hall/Community hall, Meeting hall, Theatre, Convention center/Concert hall, etc.
		10-6	Sports Facility	Gymnasium, Swimming pool, Athletic facility (public facility), Stadium/Grandstand, etc.
		10-7	Public Hospital	Hospital, Clinic, Nursing home (old people's home)/ Health care facility, etc.
		10-8	Private Hospital	
		10-9	Public Toilet	Public toilet
11	Religious	-	-	Pagoda, Monastery, Shrine, Temple, Church, Mosque, Hindo temple, Dharma hall, etc.
12	Transportation and Warehouse	12-1	Transport	Railway station, Port and airport facility, etc.
		12-2	Warehouse/Storage	Warehouse/Truck terninal, Storage, etc
		12-3	Parking	Parking garage
		12-4	Structure on a Road	Roof on a road, Entrance canopy, Arcade, etc
13	Public Utility Service	-	-	Sewerage, Water supply, Pump station, Crematorium, Power station, Transformer substation, Gas supply facility, Heat supply facility, etc.
14	Industry	14-1	Factory	Manufacture, Factory, etc.
		14-2	Automobile	Automobile garage
		14-3	Industrial Zone	Industrial zone
15	Agriculture, Forest, Fishery	-	-	Agriculture warehouse, Livestock barn, Greenhouse, Workshop, Silo, Stable etc.
16	Military	-	-	Military facility
17	Under Construction	-	-	Underconstruction and cannot confirm building use
18	Unuse	-	-	Unuse building
19	Others	-	-	Generator house, Tank, Tower, Garbage yard, etc.
20	Unknown	-	-	Unidentify building
21	Cannot See / Cannot Enter	-	-	Buildings that surveyor cannot see or cannot enter