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Development of 3D Urban Cadastre and Property Registration System: Case Study in Bahir Dar City

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***Abstract* – The current cadastral systems in Ethiopia maintain 2D geometric descriptions of parcels linked to administrative boundary records. However this kind of cadastral system is not reflecting the use space above and under the surface of the parcel. In Ethiopia Urban have various autonomous properties at various levels parcels, single family houses and etc, with overlapping property projections in a 2D unit system. In the highly urbanized areas Addis Ababa, there are properties like condominiums, Railway of Ethiopian under or above rural land, which have overlapping projections in a 2D unit system. This system promote us to increasing requirements of the complex intertwine, such as private house, condominium building, commercial buildings.**

The technique to meet the objective is that make all the cadastre parcels' elevation registration system in the cadastre works. The elevation values of the cadastre parcel corners is the main data used to model this system. Which means the main difference between 2D and 3D cadastral system is this data (elevation). At first, the 2D cadastre's polygon points are positioned and obtain the elevation values of these points precisely reflectorless EDM method. Beside this, by using the AutoCAD technologies it will be provided that the 3D model of the cadastre parcels using the original measurement values with graphical data. Starting from modeled ground parcel by using elevation data the above space parcel modeled registered.

This paper proposes a transition from the existing 2D cadastral system to a 3D cadastral system; also integrate 3D representations of the physical objects with two dimensional systems in one database. In addition to this the paper introduces the first version of a 3D urban cadastre and land registration system (3DUCLRS Version 1.0). 3DUCLRS models both the legal and physical extent of 3D properties and associated interests. A demonstration of a test system on the proposed data model is also presented.

In general this problem solves by making the elevations project of the engineering constructions.

***Keywords* – Cadastre, 3D Cadastre, Visualization System, Data Model.**

I. INTRODUCTION

Cadastre is an official public record both urban and rural land property usually maintained to register location, ownership, land value and attributes of land in a given jurisdiction, state or country (Larsson, 1990). In other words, individualization of property started originally with a subdivision of the parcel land using 2D boundaries system location based, which makes a 2D parcel to be the basic unit in existing cadastre registrations (Giaramazidou T., 2002). However, this cadastre system may not reflect the current tendency to use space above and under the surface; it means that what is on the surface of the parcel. It realizes that the 2D cadastral system cannot show what is situated on the parcel of land currently.

Population density has increased significantly in Ethiopia, which results the shortage of land among the people. As a result of this the house is constructed over each other to associate the land relation with person who need in house in Ethiopia. To full fill this need the federal The Federal Democratic Republic of Ethiopia (FDRE) constructs condominium for low income in urban area. To secure this common building registration is be required to control the security of the land.

In 2000, about half of the world's population lived in cities. According to the United Nations-Federation of International Surveyors (2009), it is estimated that almost two-thirds of the world urban population will reside in urban areas by 2030. However, most towns and cities in Ethiopia are still grapple with a number of challenges that include inadequate official land records and weak law enforcement mechanisms. The urban poor lack the ability to pay for the land while urban authorities make no conscious efforts to target the poor. Lack of transparency in land delivery often increases cases of corruption, bribery and favoritism by town and city officials. In sub-Saharan Africa, the situation of land and property registration is facing a variety of challenges.

In Ethiopia, many urban authorities are finding it quite difficult to manage with the demand for registering land transactions as well as managing the rapidly changing patterns of land uses associated with accelerated urban growth. Moreover, the absence of reliable land related information is a critical impediment to the preparation and implementation of urban development plans in many Ethiopian towns and cities.

The above challenges are often aggravated by lack of understanding of the requirements of land and digital property registration on legal cadastre; poor coordination among stakeholders, town planners and surveyors; as well as lack of skilled manpower, budget and technical resources.

This is despite the fact that land and land property registration are important aspects of the security of land tenure, collateral, reduced land disputes, increased effective municipal revenues from land lease, and increased investment.

As Stoter and Oosterom (2006) identified the basic needs for the 3D cadastre system are in the first case to have a complete registration of 3D space to which these rights apply, although the current cadastre already registers rights that entitle persons to volumes as attribute

of defined parcels. To represent and manage the 3D cadastre physical objects, 3D geospatial technologies should be employed. This system is the representation of legal boundaries of parcels is fixed in 2D space (location value); geo-spatial scientists have challenges to represent the vertical dimension of 3D real estate objects in legal documents using current cadastres (Oosterom, 2003). The 3D cadastre system should pay sufficient attentions to 3D property situations and represent the boundaries of property in all dimensions.

The second case to have good accessibility to the legal status of stratified property including 3D spatial information as well as to public law restrictions in given law. To register 3D spatial information on space rights on parcels including geographic and thematic data, to develop the relationships between the database containing 3D physical objects of the building or house on the parcel of land (such as building, house and any other permanent things around the parcel) and the location of these objects in the cadastral registration which is represented by 2D system, it implies the location of the boundary of the parcel, and to retrieve any information relate with the parcel and the legal status of the ownership with the 3D object on the parcel of land in the same database system.

In this research main investigation is that obtain the 3D on currently cadastre maps produced by total station or any surveying techniques; such as photogrammetric method, ground survey measurements method with case of using the original cadastre data. The current Ethiopian cadastre was based on the graphical or 2D system, So that these papers transform the mechanism how to register the 3D physical object on the parcel. In Ethiopia, the works is new for establishment a new cadastre system based on spatial information (object based systems). As the land information and the sheets can be updated and fitted each others in these systems, it is provided us to get the land-related 3D data on cadastral maps. This system is used for register both 3D and 2D cadastre.

In addition to this the study developing digital mechanism how to register urban cadastral system and how to store data as well as how to retrieve the stored data of the 3D property situation in 3D cadastre systems, of the pilot area (in Bahir dar, Ethiopia).

II. Objective of the Research

The main objective of this study to develop urban land registration system and transform the 2D system into a 3D cadastral registration system, so as to integrate 3D graphical representations of the physical objects on the parcel (whether it can be Apartment, House or any other permanent features on the parcel).

The Specific objectives of the study are:

- To obtain the 3D on currently cadastre maps produced by ground surveying method with case of using the original cadastre data.
- To develop the 3D physical object (3Dcadastral system in Ethiopia for better security).
- To develop a system for a 3D registration system that can be implemented under the existing environment in Ethiopia.
- To registering the parcel of land with the physical object on the given parcel in one database system.
- To develop the storage database management system, both graphical and coordinate storage in database management system.

III. Research Problem

One of the largest cities in Ethiopian cities is Bahir Dar City; it has disorganized land and land-related property registration system (permanent object on the parcel). Today vertical urban development is usual in all country of the world, in Ethiopia also vertical development are common. Especially in Ethiopia, from recent condominium housing is strategic for Ethiopian federal government. The allocation of urban land to a high rise or a row of houses condominium building will contribute to maintain the beauty of the urban areas. Not only this it improvement of urban land use and supply of housing through making great number of people benefit and commonly hold a small size of urban land. Since the condominium house is divided into the several parts or units for different ownership, the main problem is to clearly define and protects the right of the 3D property in this cadastral system.

The main research problem of 3D urban cadastral system and registration are: The 3D component of the cadastral system are not registered in Ethiopia currently, in conventional parcel based cadastral system cadastral map are not succeed to display what is object to be situated on the parcel of land.

The problem of the current system such that land delivery system: too much unnecessary bureaucracy; lack of modern technology to store data on land; lack of financial resources and human capacity.

The legislation in 3D land right is unclear in Ethiopia, many conflict seen to exist between laws and statutes in current cadastral system i.e. the system and development in the sector of urban land is not clear in Ethiopia.

Land tenure is the land use right which is time limited in Ethiopian law: example the resident land use time is 99 years and the commercial land use time is 50 years, 90 for educational purpose (Federal urban land lease proclamation No. 272/2002). As results different land valid times may exist in an integrated 3D object and then the land valid time for the whole parcel is difficult to decide. To regulate this time limit land owner this developed system is clearly allow registering.

This research establishes that the Municipality of Bahir Dar did keep up-to-date land and property registration records and digital urban cadastral maps for both urban and rural land administration. The only recording systems that existed were being carried out manually by an administration clerk who only recorded the name of the owner, the plot size and the use of the plot. Important features such as the location, physical object on the parcel, boundary demarcation and other relevant attributes were not recorded. This system advantages for permanent features on the parcel also recorded with spatial

information of the owners and 3D physical plan of the house on the parcel.

IV. Research Question

Based on the specific objective set for this research the research question in 3D modeling and registration of 3D cadastral object exist in legal, organizational and technical aspects .Due to the complexity of ownership of land and building, to develop a mechanism for registration and managements of the 3D object and to use a particular model to execute the registration are chosen as the main goal.

The following research questions are addressed in these research activities.

- How to implement and manage the registration of 3D condominium apartment unit in major Ethiopian city?
- What are the needs of 3D cadastral system for current Ethiopian cities?
- How to model the 3D urban cadastral system and 3D object for 3D registration?
- How to design and implement the 3DUCLRS for querying and editing ownership and other information for better land management system? As well as what are contents needs for the 3D urban cadastral system development

V. Condominium Housing and Registration in Ethiopia

[1]Condominium housing is a name given to the form of housing tenure where each resident household owns their individual unit, but equally shares ownership and responsibility for the communal areas and facilities of the building, such as hallways, heating systems, and elevators. There is no individual ownership over plots of land. All of the land on a condominium site is owned by all homeowners. Usually, the external maintenance of the roof and walls are undertaken by a Condominium association that jointly represents ownership of the whole complex, employing strict management to ensure funding from each homeowner. This association consists of representatives of all condominium residents who manage the site through a Board of directors, elected by association members. A register of condominium units and common areas on site and any restrictions on their use is commonly established in a master deed which authorizes the Board of directors to administer condominium affairs and assess owners on their performance of adequate maintenance. Rules of governance are usually covered in a separate set of regulation which generally governs the internal affairs of the condominium blocks.

Regulation usually establish the responsibilities of the Condominium association; the voting procedure to be used at association meetings; the qualifications, powers, and duties of the Board of directors; the powers and duties of the officers; and the obligations of the owners with regards to assessments, maintenance, and use of their unit and common areas. A set of rules and regulations, providing specific details of restrictions and conduct, are established by the Board and are more readily amendable than the declaration or regulation. Typical rules include mandatory maintenance fees (often a monthly collection), pet and livestock restrictions, and color/design choices visible from the common areas of the buildings. The upkeep of walls and features inside a condominium unit is the sole responsibility of homeowners themselves.

This area is defined as the area bounded by the walls of the building, allowing the homeowner to make some interior modifications without creating an impact on the common areas.

These boundaries are specified by a legal declaration, filed with the local governing authority. Anything outside this boundary is held in an undivided ownership interest by a corporation established at the time of the condominium's creation.

Condominium unit owners can be permitted to rent out their home to tenants, although leasing rights may be subject to conditions or restrictions set forth in the original declaration, such as a rental cap on the total number of units a community can lease at any one time, or otherwise as permitted by local law. The programme recognizes the opportunity for housing to stimulate the economy, create employment, and improve the capacity of the construction and financial sectors.

The future plan for the urban cadastre registration will be registering the plan before the constriction started depending on the architectural plan.

VI. 2D Cadastral Data Models

The 2D cadastral data models consist of three main components: these are main component to represent (register) parcel. Person who Holder the parcel; (Rights) this referee the person have right to use the parcel, Restrictions (person who hold the parcel not to sold for other person), and Responsibilities the responsibility of this person is he have to keep the fertility of parcel such as soil. Holder can be a single person, group, or an organization that has certain rights over a particular extent of land. In Ethiopia the owner of the building may be one person or in different owners (organization). In 2 D system these components have very strong relationship with each others. On the time of registration the spatial data need was the coordinate of the parcel corner, the owner of the parcel, area of the parcel, farmer sharing the boundary, region, village name and kebele (Solomon Abeba, 2000).in addition to the spatial data need for 2 D cadastre registration the physical object on the parcel and the spatial relationship between the object should registered in 3D urban cadastre.

The 2D cadastral land parcels are being used as a basic building block of the current land administration systems. There are a number of reasons why current cadastral data models still have problem on the 2D land parcels for accommodating 3D data. The main reasons are lack of 3D

[1]Condominium housing in Ethiopia: the integrated housing development programme

data collection methods and equipment, and Limited 3D storage system (database management system) and representation technologies (3D data base management system). However, 3D cadastral system developments changed the characteristics of land parcels.

Adding to this complexity were an increasing number of different right, responsibility and restriction (e.g. ownership, easements, lease, planning zone, heritage protection area) are associated with one 2D land parcel.

The 2D land parcel is no longer the appropriate basic spatial component of cadastral models for managing and modeling 3D information; 2D land parcels have been superseded by 3D spatial places. People now own and use volumes of space that can be determined in a 3D coordinate system (Rokos D., 2001). So, that 3D cadastral system can solve this problem to fill the gap between parcel based and object based registration system.

VII. Needs for Developing 3D Cadastral Data Model

3D cadastre is defined as it is a system, which registers rights and restricted rights on 2D parcels and 3D property situations above and under the surface in the 3D aspect of rights. The 3D property situations refer to situations in which different property units (with different types of land use) are located on top of each other within complex structures. This complex structure may be owned by different holders such us private house or commercial apartments. The 3D cadastral modeling is based on three components: object, subject and right (Sarafidis, D., 2001). Objects are parcels and apartment rights linked to a 2D ground parcel, and subjects are legal owners with rights on the parcels. In order to register 3D property situations (condominium house) together with parcel objects, 3D physical objects (apartments, private house etc.) should be identified and represented as cadastre objects, together with these objects‟ ownerships. Therefore, the components of 3D cadastre models include 3D parcels, 3D right-objects, 3D right-object is a 3D representation of a right that is established on a 2D parcel and concerns a 3D property situation, and 3D physical objects, which are linked to administrative data including ownerships. These components are a 3D property unit (or 3D real estate object), which is a bounded amount of space to which a person is entitled by means of rights (ownerships).

In the present study the registration process are included: the object on the parcel by three dimensions, the boundary of the parcel and the legal right of the owners on the parcel (such as the type of the owners, from where he got the land and others.) stored in the same database. This is advantage for controlling the security of land owner and government tax.

The boundary of 3D right-objects starts with the parcel boundary and is extended into 3D by means of defining the upper and lower limits of the right.

The 3D right-objects are associated with, and contain a reference to the physical objects, which consist of actually built constructions, such as tunnels and apartments. The registration of a 3D physical object consists of two kinds of rights belonging to this particular 3D physical object, which are a right of (infrastructure) easement and apartment rights. In order to register the 3D physical objects the apartment is considered as a compound physical object containing a set of apartment units (property units), which are associated with a registered right for each apartment (Stoter et al., 2004). However, this approach requires considerable adjustments of the current cadastre registration system, technically and administratively in Ethiopia.

For the implementation of this system, both technical and administrative issue is raised. Technical point of view, it is more difficult to collects and to maintain spatial and non-spatial characteristics of 3D physical objects in the system because the spatial representation and analyses of physical objects are more complex than those of 2D right-objects. In order to resolve these problems, this study proposes to develop a spatial data model to represent cadastre objects, especially 3D physical objects in the 3D cadastre system by elevation data. The 3D cadastral data models have been developed to support the 3D cadastral system in Ethiopian. In the most cases, a common spatial unit has been defined to support 3D requirements. This object maintains, for example, 2D land parcels, buildings, and utility network objects. The 2D land parcel object is being used when the model deals with a land parcel, and the building object is being used when a building is being modeled.

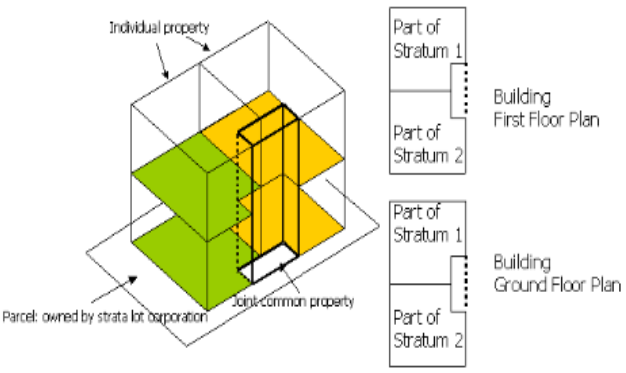

Fig.1. Graphical Apartments

VIII. 3D Cadastral Practice in the World

Different countries in the world faced with the complexity of three dimensional cadastral registration systems because of the 3D property situations. Developments to face and solve these problems depend on the national legal system and the state of the art of the cadastral registration in the specific country.

The factor that seems to influence the cadastral 3D registration is the basis of the legal system. For example, in the Netherlands the concept of property rights to real estate is still land (surface) oriented, while in Ethiopia it is the complications of 3D cadastral registration at the juridical level. The legal system in these countries provided the possibility to establish multilevel ownership no longer related to surface parcels.

In most countries apartment rights (condominium rights) or strata titles are used to establish 3D property units. The registration of apartment rights is different in every country. However, there are no cadastral registrations known in which the spatial extent of apartment units is registered (in 2D or 3D) as part of the cadastral geographical database.

Kenya, South Africa, Australia and England (basically all Common Law countries) use strata titles in the case of 3D situations. The land registration contains an analogue or scanned drawing of the situation. This drawing includes an overview of the complete parcel divided into individually owned units and common property, augmented by the cross sections of the diff erent building. These drawings are not incorporated in cadastral registrations.

The main short comings of Dutch cadastral registration in case of 3D property situations is that the 3D situation is projected on the surface and that the spatial extent of rights is not available in the cadastral registration. In addition, the real situation is not properly reflected in the cadastral registration, e.g. by showing (3D) outlines of physical constructions above and below the surface.

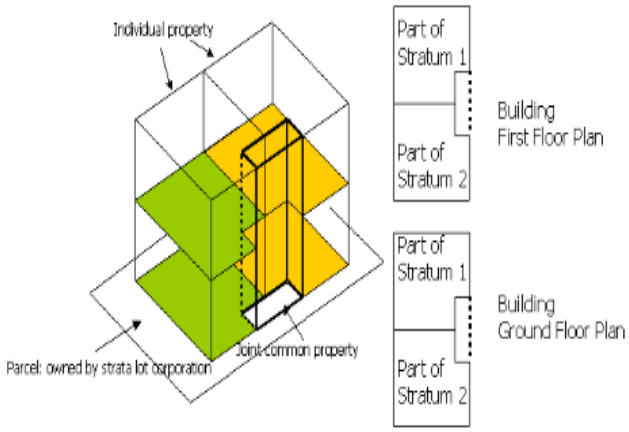

Fig.2. Example of drawing in stratum title: Source by courtesy of Michael Barry

IX. Policy and Legal Frameworks Related to Housing In Ethiopia

Since 1991 Ethiopia has had a decentralized regulatory structure with considerable autonomy devolved to regional states regarding the management of their internal affairs. Ethiopia has divided in to nine regional state and two autonomous administrative cities (Addis Ababa and dire dawa). Each state comprises zones, Woreda, cities, and neighborhood administrations Kebele. In each region the districts are the basic planning unit and have jurisdiction over the kebele. The capital city of Addis Ababa has ten sub-city administrations containing 11 elected executives and 128 councilors at city level. There are 99 Kebele within the capital and 300 councilors between them to represent 30,000 people. All land is property of the national government and is leased, not sold, for development in Ethiopian land law.

Until recently, there were few national coordination policies regarding housing and urban development. In 2005, the Council of Ministers of the Federal Democratic Republic of Ethiopia formulated and approved a consolidated Urban Development Policy to link together the small-scale efforts made by regional governments and cities since 2000. They also created the national Ministry of Works and Urban Development (MWUD) to guide the overall development of the country's urban areas and conducting studies on its urbanization patterns.

Within MWUD, the National Urban Planning Institute is responsible for preparing physical urban development plans, the Housing Development Bureau works towards the implementation of the IHDP including the MSE Development Programmes, the Urban Development Support Services deal with financial planning, human resources, and capacity building.

Very few private housing developers exist. The private construction industry is very small and it is complicated and time consuming to start a company, register it, and conduct business. Those that do exist operate only for high-income groups as there is little incentive to construct low-income housing. Since the late 1970s housing cooperatives have also provided an opportunity for home ownership.

A. Legal frameworks

While the following list is not comprehensive, the key laws relating to the integrated house development program (IHDP) are: Proclamation No. 172/2002 pertains to the lease holding of urban land, with all land in public ownership.

Proclamation No. 272/2003 stipulates that land is provided free of lease charge for low-cost housing developments. Proclamation No. 370/2003, The Federal Condominium Proclamation, pertains to condominium housing. It defines condominium as "a building for residential or other purpose with five or more separately owned units and common elements, in a high rise or in a row of houses, and includes the land holding of the building" Proclamation No. 19/2005 deals with beneficiary eligibility criteria and selection and penalties for noncompliance.

Proclamation No. 455/2005 affirmed the basis and amounts of compensation for displacement and land expropriation. 90 days notice period must be given; compensation is to be paid at market value; relocation costs incurred must be met; and rental and ownership options must be provided at fair prices, in the same or nearby location.

Regulation No. 15/2004 outlines the establishment of the Addis Ababa City Government Housing Development Project office and outlines its duties and responsibilities. Regulation No. 12/2004 outlines the condominium regulations for Addis Ababa city, regulating further details to Proclamation No. 370/2003. From this historical background Ethiopia has not 3D laws, even if the development is in vertical. The researcher recommends it needs to have 3D urban land law proclamation and regulation.

X. Case Study

The pilot area is selected, a building subdivision plan has been used as a case study to test and analyze the deficit of 3DULRS Version 1.0. The case study is a Condominium building around kebele 14 Bahir Dar, Ethiopia, which has been subdivided ground plus four (G+4),used for resident purpose (Figure 6).

Fig.3 Study site, common building in Bahir Dar, Keble 14

XI. 3D Data And 3D Modeling

3D data are captured by ground surveying, this is the key task for this work the next step is spatial modeling of urban cadastral. By collecting all coordinate of the boundary with its elevation by reflectorless EDM mode. Comparing to the general modeling of common geographic features, such as road, block and building, 3D cadastral systems focus on creating 3D models of all cadastral objects, including 3D land parcels, 3D buildings, 3D property units and there collection.

Also the 3D boundary of the cadastral objects should be accurately collected. Formally, the cadastral data are derived by certain people and group of sections in the municipality. Generally, the geometries of the boundary of the building are surveyed and mapped by surveyors, and rights and semantics are authorized by specific laws and regulations, contracts and governments.

From the perspective of geometry, the existing 2D cadastral system is already showing the 2D parcel. However, it is evident that a 2D cadastral map cannot describe the 3D space and their relationships, this described by the elevation from the 2D location. 3D geometric representation is necessary to delimit the 3D space that the owner possesses with certain rights, restriction and responsibilities. The foundation of all 3D parcel map are the 2D parcel boundary, which is the common property for all .this means that if the two dimensional coordinate of the boundary are known this coordinate are the same for all which are vertically over the parcel, the only difference is the elevation of each unit. So, that condominium building can be registered by its elevation from each ground (first floor to the next). In Ethiopia the following figure shows the existing cadastral system which shows graphical system. This is bases for 3D cadastral modeling system.

To model this 3D building data modeling, starting from transforming the coordinate of the boundary. This allows as digitalizing by AutoCAD software to model the 3D building. Basically, the 3D data source is from Ground surveying, 3D laser scans or ortho images can provide certain 3D data, but these 3D data mainly concern physical shapes and are not feasible for 3D cadastral context. If the plan of the apartments available the 3D registration is simpler, it does not takes place ground survey.

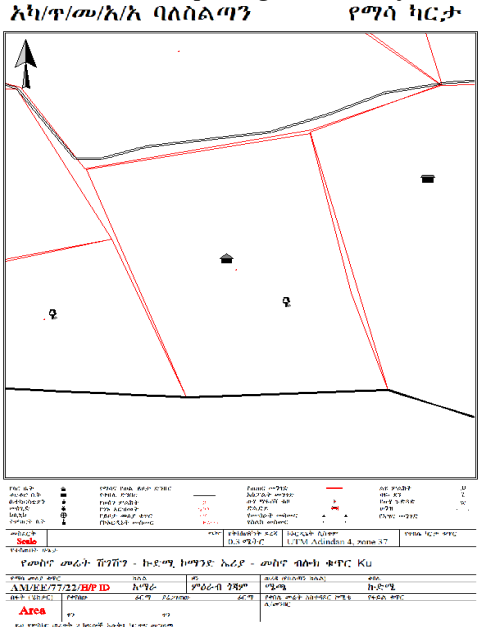

Fig.4. Current 2D cadastre parcel map of Ethiopia(This is the 2D parcel certificate paper issued for farmers)

During this modeling process, the plans of the building or proposed buildings should be available, and the height of the Building should be known. Secondly, a direct approach is to straightforward detect and recognize the valid 3D solids from the given 3D boundary facade. Last, 3D cadastral models can be imported from 3D Building in AutoCAD to the database management system. In this study the only the outer boundary of the property unit is needed in 3D cadastre it is very difficult to collect data for the internal boundary of the units, however for this study we collect by using tape method which is the lowest accuracy. Also the geometric location is a little different because there is thickness information walls in City, but cadastre only pay attention to the linear legal boundaries without thickness that may be depicted by physical walls.

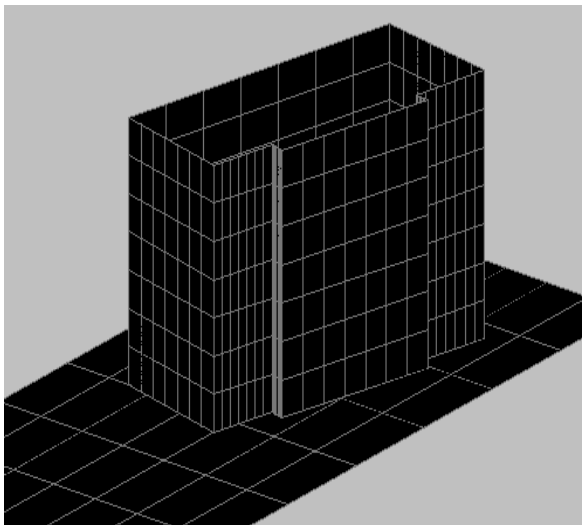

Fig.5. Unified representation of condominium building

The collected data for this task is the outer boundary of the building and the height of each floor of the building, additionally the condominium building are not irregular shape to measure directly, to convey this the researcher use traditional method to measure the inner studio.

By its nature the Ethiopian condominium plan is not comfortable for cadastral data collection for registration, because its shape is not regular.

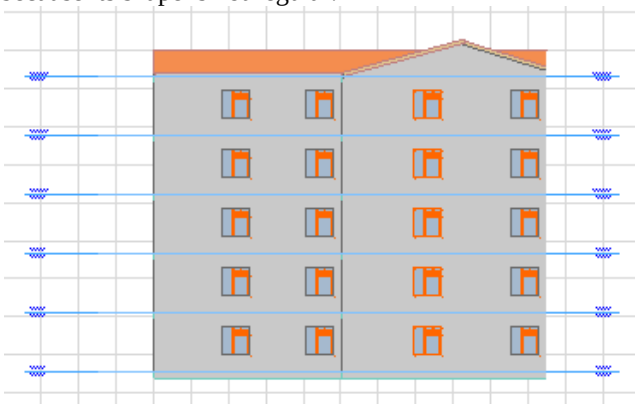

Fig.6. Urban 3D modeled building around kebele 14

During the modeling of 3D cadastral objects, more attention has to be paid on the legalization of 3D models, especially for sets of property units that need consistent and precise geometric as well as topological relationships among 3D cadastral objects. Each 3D volume cadastral object has a closed 3D space represented by 3D geometry, which needs effective methods to validate its closeness and interior connectivity. Many solid modeling tools put up the discrete faces together without inherent 3D structure to represent 3D geometries. Direct construction of valid solids from discrete faces and real 3D geometry can provide an efficient approach to model 3D cadastral objects (Ying, Guo, Van Oosterom, et al., 2011).

3D provides a certain spatial database to manage 3D cadastral objects, which enhance the level of the 3D information management and improve the efficiency. Updating and maintenance of the 3D cadastral objects is also necessary to change or update information. The real 3D geometric primitive 3D body is defined, and also two feature class's 3D land/legal space and 3D construction/building space that are inherited from class 3D Parcel are defined and associated with the geometric 3D body.

The modeled property and all the objects can be directly stored in an SQL Server database with its own structure for further accesses and updating. Database schema of our 3D cadastral project is expressed , moreover, detailed relationships and links among the different geometric primitives and cadastral objects are portray in the diagram, as well as class definitions of the attributes of each class.

3D URBAN CADASTRAL LAND REGISTRATION SYSTEM (3DUCLRS)

Recently Ethiopian city shows very rapidly growth in Africa in different activity one of this development is urban development. We can see urban development in two ways: one is horizontal development and the other one is vertical development. The vertical development is very increasing in different Ethiopian cities example condominium house. Because of that this real property has to register to secure the property. To secure the modeled data in one package for urban cadastral system is very necessary. This is small and easy to use for all land administration Berou. The system of this part is presented in this section. To develop this essay user interface is needs seven different seven packages to support the 3D cadastres and registration system. They are 3D object Holder, 3D Property object, 3D Geometry, 3D Survey, 3D Survey Points, 3D Survey Observation, and 3D External Sources. This is the hierarchy to register urban land with object situated on the parcel and spatial attributes related with 3D owners. The 3D Cadastre object modeled in AutoCAD and exported to SQL database management system and the attribute related with the 3D object is saved in side SQL and connected inside 3DUCLRS which developed. Anyone can retrieve information by entering ID or the apartment identification number. The permeation to edit information is authorized for land administrator only.

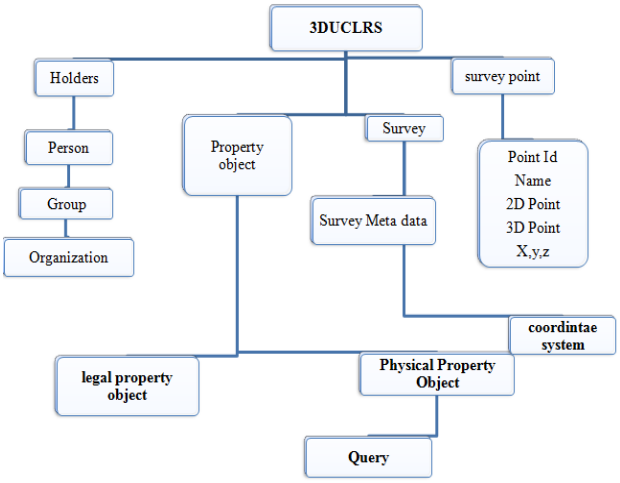

Fig.7. Structure of 3DUCLRS

After this connection (the modeled features and the database information) although registration and rights are the essential elements in land administration systems, the core element that they are imposed on is the land parcel, with its 3D land space.

Currently, 3D cadastre is a separate division of 3D urban features, such as buildings, tunnels, underground constructions, construction over each other, are the 3D cadastral entity. From the perspective of space, land, buildings and all the other entities are coherent for 3D cadastre. The rights, restrictions and responsibilities that people own and undertake associated with these entities are equal to that associated with the corresponding geo-space of these entities. So land and other real estate's or properties are consistent in the aspect of geo-space, and 3D geo-space management provides a uniform framework for 3D cadastre. All the 3D cadastral objects can be located unambiguous with geo-referenced coordinates, and occupy an exclusive volume of geo-space.

These occupations of geo-space are the most important part and the essence of 3D cadastral objects. Through their

International Journal of Research and Innovations in Earth Science
Volume 2, Issue 3, ISSN (Online) : 2394-1375

management, the 3D cadastre upgrades and transcends the exiting management system of land and real estates.

3D cadastral space unifies the physical construction space with the legal space.

Although a 3D cadastral object occupies some geo-space, its geo-space may not be fully filled by physical entities. For example, current Ethiopian system in case of condominium the physical unit is not yielding with the reality inside the room, to represent these phenomena. There are two that are overcome this problem in this research.

First, the difference between the physical space and the "air" space is drawn in different ways, and the "air" space is represent with wire frame or different colors to show its difference with physical space because the owner has right only on the unit. Notably, these two types of space are inseparable and there is only an integral space including both of them. Another way is to show the holistic legal space regardless of the physical space. Since the 3D geographic space is homogenous in legal aspects within one 3D cadastral object, there is no difference between the physical and "air" space, and they can be modeled and visualized in a unified way. In this research the condominium house have integrated right for the 2D parcel. In a full 3D cadastre system, a volumetric parcel is not necessarily visible in reality and only indirectly related to physical objects (Döner, Thompson, Stoter, et.al. 2011). Next, the researcher elaborated the details of the applications, procedure of 3D cadastre modeling system in three aspects: 3D building modeling, visualization system, and decision-making support.

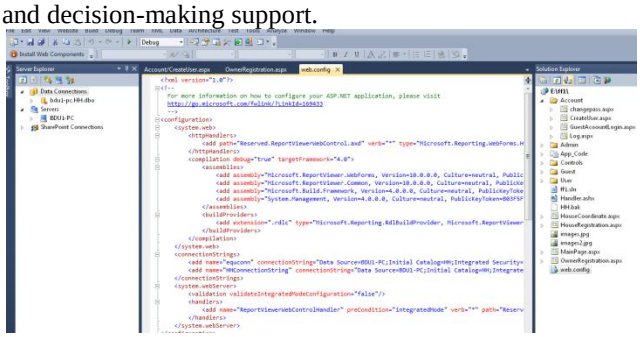

Fig.8. General developed codes for the user interfaces developed

XII. Registration System and Process

After all modeling activity is finished registration system has to followed, to do this the researcher develops the system 3D urban cadastre and land registration system (3DUCLRS) was developed.

There are requiring the registration of the property, the registration of the Public building and government building have developed complete, flexible, custom applications for the registration, management and operability of their own networks in order to ensure their un hindered operation, being responsible to keep them updated, upgraded and at the state of the art.

So even if these networks are located below the surface of the ground or in the air and could constitute 3D cadastral data, it is commonly agreed that the organizations themselves have better know-how and can surely manage more completely and efficiently their property, excluding it from the data registered in the Cadastral system. The registration procedure combined with the authorized as figure 1 below shows the system not allows to free access. As (Figure 1) shows the interface ask password and user name to allow administer to do data editing, insertion and deletion. In addition to that, users couldn't have opportunities to query and visualize the building units without the authorized company (Figure 1).

Password Authentication

A password was used to gain access into the system to avoid unnecessary interference by unauthorized people. This is achieved by the use of the PASSWORD table in the SQL database. User must seek or apply for the permission to access the System through the figure 9 below and the system respond if the password allow assess the system. So the system administrator uses his own prerogatives to grant the permission.

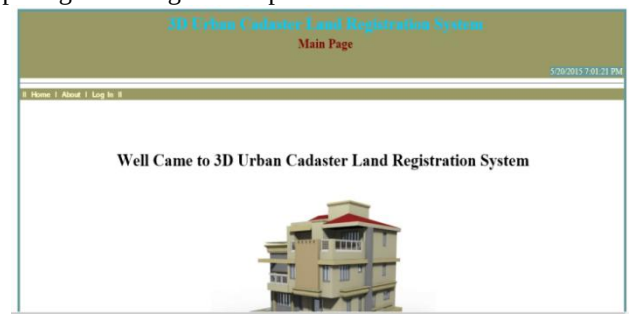

Fig.9. Login Interface.

In all the world the land issue is very sensitive and complex issue the authorities have give attention the security of land. After the user give user name and password the welcome page appear as showed the following page. The authorized authorities have permission to accesses the data collected and retrieve by the owner ID or by name. This interface allows as registering the new owner to the database management system through the registration system.

Here the system designed to asses three different authority administrators, User and Guest can assess the system. The role of the administrator is allowing the user to register the customer and print out and issues for the customer, here the user can not to asses without the permission of the administrator. The other one is guest any one can asses or visualize the information by using the land owner ID. The following figure shows the login page for user, administrator and guest.

Fig.10. Welcome page after sign in to the system

International Journal of Research and Innovations in Earth Science
Volume 2, Issue 3, ISSN (Online) : 2394-1375

The administration role given for the administrator of the system it may be the Municipality council or the land administrator. The administrator can create the account for the user, and change password when needed.

Example if the user changes his position the other person replace his position then the administrator have to change user ID and password for the user.

Fig.11. welcome page of administrator

Administrator create user name and pass word for the user, the following figure shows the role of the administrator.

Fig.12. Admin page

The main role of Administrator also change the password for the user and administer all activity which done by user.

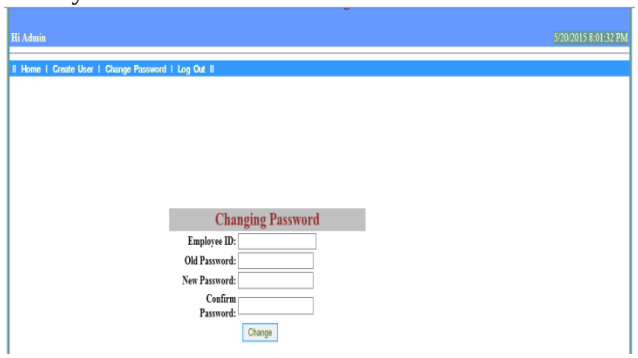

Fig.13. Admin change password

After the administrator allow user to register the customer application user have to logout the administrator page and login by the user ID. There are three main tasks under taking in the page, the first one is registration of the owner of the parcel or house is registered here. The land information system also registered here. In addition to this the report also generates and prints out the report to issues for the owners.

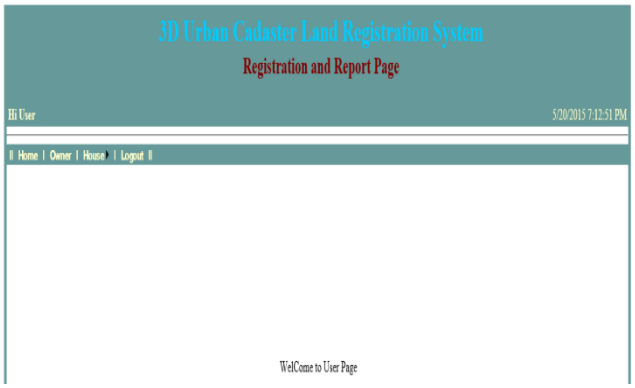

Fig.14. welcome page of User

Data for the system was entered through the designed interfaces with a carefully selected coloration to add to its esthetic quality. A sample for the administrator information is shown in Figure 12. From the figure, it could be seen that the user could add, delete, and update data. User could as well navigate through the bulk of data in the table so as to view the information. The municipality can issues the certificate for the land owners. The municipality can edit and register the new registration also can change the password. The following page allows as registering the new registration data to database management system.

The registration includes ID of the owner, name, sex, marital status see figure below.

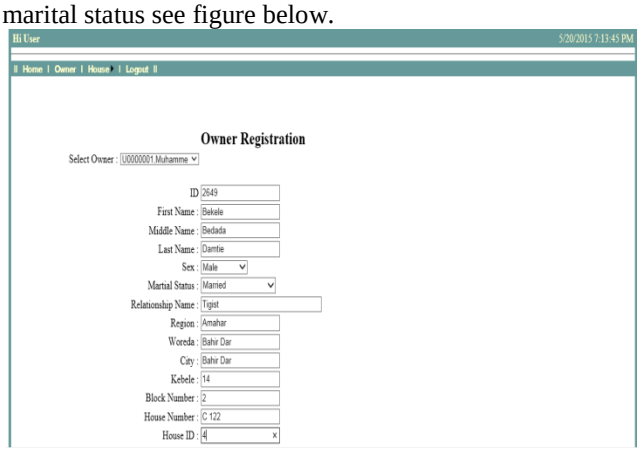

Fig.15. Owner Registration Data Entry Interface 1

International Journal of Research and Innovations in Earth Science
Volume 2, Issue 3, ISSN (Online) : 2394-1375

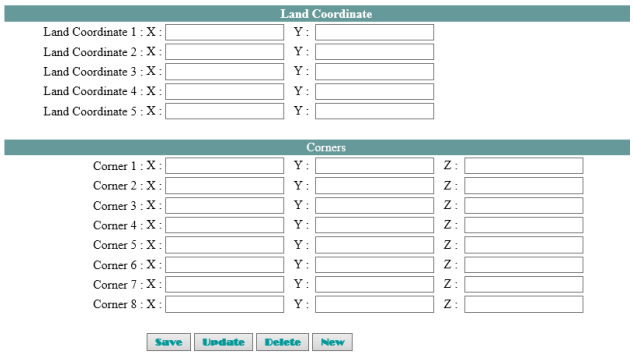

Fig.16. Data Entry Interface 2 Figure 14 Registration of parcel information

A. Visualization

Without visualization of 3D objects, 3D property cannot be represented in the so called 3D cadastral map which shows the location of objects and properties in space. The visual obstacles of physical entities or nest relations among different geo-spaces result visualization in difficulties. The aim of visualization is to show the location, as well as the context of 3D cadastral objects and highlight them on the same page.

These parts describe the technologies facilitating visualization of the distinct location relationships of 3D cadastral physical objects with the owner of the 3D object. The interface prepared or developed for visualizing information and registering the new real property 3D Urban Cadastre land registration system (3DUCLRS) visualize and updating any information.

In terms of visualization, there are many differences between 3D cadastre and virtual city/architecture, and emphasis is shifted from urban simulation to the distribution of 3D land space, 3D property units and other cadastral objects. Proclamation suggests that registration of condominium Subject to provisions of this Proclamation, a building may be registered as a condominium when the owners or their agents submit written application declaring the intention that the building be governed under this Proclamation together with a declaration; description, by-laws, and rules. The contents of declaration, description by-laws and rules shall be determined by the Regulations issued to implement this Proclamation. The declaration description by laws and rules shall be approved and registered by the registrar. Under the same proclamation number five the Certificate of registration shall be issued for the declaring where the building is registered under this Proclamation.

In this study the certificate or the reports are developed after the registration of the unit owners and this certificate is issued for the unit owners.

Visualization for architecture focuses either on the holistic view and harmonic fusion of the architectures and the surrounding environments, or on the functional division or the configurations of the interior of the architectures. The visualization for architectures emphasizes the reality of architectural entities and their functions, and stresses the visual effects of the exterior surface or interior construction. Objects for architecture visualization are walls, doors, windows and so on. Other visualizations, such as urban simulation and virtual city, focus on visual simulation of the exterior "skin" of the city.

The main output of the query or visualization figure 17:

- The results Show the precise boundary of property units and its 3D location.
- Its geospace may be delimited by the physical walls or fences of the parcel.
- The visualizations of 3D cadastre illustrate the distributions of occupations and partitions of land space and urban space to give clear ideas for users or to support decision-making for the government.
- The geometric boundaries of the 3D cadastral objects are the statutable or legal geographic surfaces, (a closed volume).
- The report delivered for the customers also visualized in the report column.
- The print page also appear on the same page to issues the report with authority seal

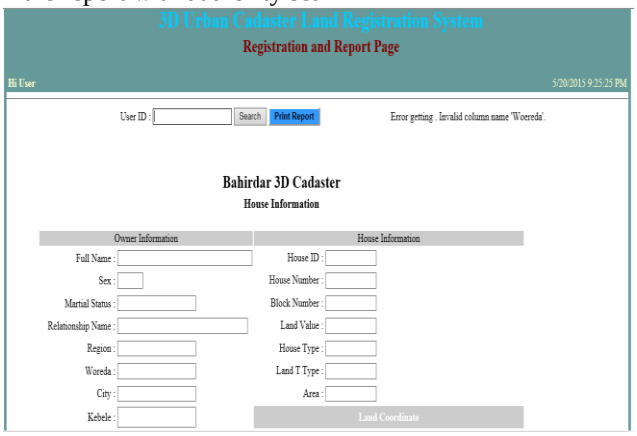

Fig.17. Quarry page

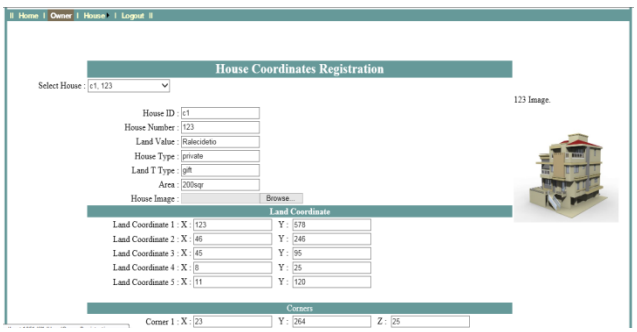

Fig.18. Report page

They pay more attention to the facade surfaces of the models and to photo textures for photorealistic looks, not to the interior "units" under the skin and the number of the unit. This study focus on the facades surface not to the interior of the unit but the area of the unit must be recorded in the system by the owner ID.

XIII. CONCLUSION

We can define as a 3D Cadastral system, a system which provides information about land-use above and below the surface of the earth, aiming to its best and profitable utilization. Critical to the system's success is the

compatibility of the relative legislation to its specifications, or vise-versa the adaptability of the system. A successful 3D Cadastral system constitutes a unique tool, a lever for any effort for sustainable development in urban and land planning and in every aspect of technical, financial, social and legal issues of our everyday life. It can also be used as a means for political decisions and pressure.

The developed 3D cadastral and land registration system was applicable for rural land registration also not only 3D.Any one can use for the rural land registration by 3DUCRS Version 1.1.

An up to date 3D Cadastral system should evolve through:

- The modernization of the relative legal frame, through (which is in charge for the project) and its evolution to a Cadastral Code, defining every different type of ownership right and the way it should be registered and managed.
- The reformation of the specifications of the project in order to include the registration formula of complex legal rights. So, a categorization of the legal rights is necessary in order to achieve the smoothest, fastest and most economical transition from the bi-dimensional registration to the 3D Cadastre:
- Newer properties developed during the period that the Ethiopian Civil Code was in value, (no floor-ownership), could be treated respectively
- a legal frame should be developed, for the properties to be formed in the future in Ethiopia governments.
- Based on this investigation Properties with simple ownership status, should update their database information by providing a floor reference up to all building unit.
- The inevitable transition of the Real Estate legislation, to the state that any property can exist not necessarily connected to a land-parcel.

REFERENCES

[1] Giaramazidou T., 2002, Legal and technical aspects of registering three-dimensional cadastral objects, Post-graduate thesis, School of Rural and Surveying Engineering, AUTH.

[2] Greek Government, 1998, Law 2664/98: National Cadastre and other provisions.

[3] KTIMATOLOGIO S.I., 1999, Hellenic Cadastre Technical Specifications

[4] Ntokou K., 2002, Spatial processes of documentation of 3D property objects information, Post-graduate thesis, School of Rural and Surveying Engineering, AUTH.

[5] Rokos D., 2001, Conceptual modeling of real property objects for the Hellenic Cadastre, International workshop on "3D Cadastres", Registration of properties in strata, Delft, The Netherlands, November 2001.

[6] Sarafidis, D., 2001, ASAR-GIS: Software of spatial data management of the Hellenic Cadastre project.

[7] Stoter J., Salzmann M., 2001, towards a 3D Cadastre: Where do cadastral needs and technical possibilities meet, International workshop on "3D Cadastres", Registration of properties in strata, Delft, The Netherlands, November 2001.

[8] Solomon Abebe, 2000, Land Registration System in Ethiopia Comparative *Analysis of Amhara, Oromia, SNNP* and *Tigray Regional States, Ethiopia.*

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