

# Prosiding Seminar Nasional Geomatika 2019

ISSN 2614-7211



## *Geomatics Scientific Meeting on Planning and Disaster "Coastal Management to Support SDGs"*

Bandung, 18 September 2019



**PROSIDING SEMINAR NASIONAL GEOMATIKA 2019:  
GEOMATICS SCIENTIFIC MEETING ON PLANNING &  
DISASTER**

*"GEOMATICS SCIENTIFIC MEETING COASTAL MANAGEMENT  
TO SUPPORT SDG'S"*

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*Edisi Vol.4, Desember 2020*

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ISSN 2614-7211 Pusat Dokumentasi Dan Informasi Ilmiah-LIPI

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Prosiding Seminar Nasional Geomatika 2019  
Cibinong: Badan Informasi Geospasial

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### **Katalog Dalam Terbitan (KDT)**

Prosiding Seminar Nasional Geomatika 2019:

Geomatics Scientific Meeting on Planning & Disaster

Theme: Geomatics Scientific Meeting Coastal Management to Support SDG'S

Cibinong: Badan Informasi Geospasial, 2020.

222 hlm

ISSN 2614-7211

## KATA PENGANTAR

Segala puji dan syukur dipanjatkan ke hadirat Tuhan Yang Maha Esa atas segala rahmat dan karunia-Nya sehingga Prosiding Seminar Nasional Geomatika 2019 yang bertemakan *Geomatics Scientific Meeting Coastal Management to Support SDGs* dapat terbit online sesuai waktu yang direncanakan. Tema seminar ini dipilih untuk mendorong pemanfaatan data-data spasial dalam pengelolaan wilayah pesisir yang berorientasi pada pencapaian target-target SDGs. Melalui pemanfaatan informasi geospasial diharapkan wilayah pesisir yang menjadi wilayah konsentrasi peradaban dapat menghadapi tantangan pembangunan ke depan yang semakin kompleks. Melalui perencanaan yang baik dan komprehensif diharapkan pencapaian target SDGs dapat segera terealisasi.

Prosiding ini diterbitkan setelah melalui proses review terhadap makalah dan dilakukan perbaikan oleh penulis. Beberapa makalah tidak diikutsertakan pada Prosiding ini karena beberapa alasan, diantaranya karena beberapa tulisan terbaik, dengan seizin penulis, akan dimuat pada Jurnal Ilmiah Geomatika dan Majalah Ilmiah Globe. Alasan yang kedua adalah karena beberapa makalah lainnya yang telah melalui proses review tidak dikirimkan kembali ke panitia.

Atas nama panitia saya ucapkan terima kasih kepada seluruh peserta seminar yang telah meramaikan acara seminar ini, khususnya kepada penulis yang telah memperbaiki makalahnya untuk Prosiding ini. Terima kasih juga kepada seluruh panitia dan reviewer yang telah bekerjasama dalam mempersiapkan, mengawasi jalannya acara hingga menyelesaikan Prosiding Seminar Nasional Geomatika ini. Semoga Prosiding ini dapat bermanfaat untuk Penggunaan, Pengembangan produk dan Penyebarluasan hasil riset informasi geospasial.

Akhir kata, mohon maaf atas kekurangan dalam penyelenggaraan Seminar Nasional Geomatika 2019. Kami akan terus berusaha menyelenggarakan Seminar Nasional Geomatika yang lebih baik setiap tahunnya. Semoga Allah Subhanahu wa Ta'ala meridhoi segala niat dan usaha baik kita. Amin.

Cibinong, Desember 2020

Ketua Panitia,



Yosef Prihanto

## KATA SAMBUTAN

Puji syukur atas rahmat Tuhan Yang Maha Kuasa kegiatan Seminar Nasional Geomatika 2019: "Geomatics Scientific Meeting On Planning & Disaster yang bertemakan Geomatics Scientific Meeting Coastal Management to Support SDG'S" telah terlaksana dengan baik pada 17-18 September 2019 yang lalu. Seminar Nasional Geomatika ini merupakan kegiatan tahunan yang dilaksanakan oleh Bidang Penelitian, Pusat Penelitian, Promosi dan Kerja Sama.

Selaku Kepala Pusat Penelitian, Promosi dan Kerja Sama, saya menyambut baik terbitnya prosiding ilmiah Seminar Nasional Geomatika ini. Tentunya prosiding ini telah ditunggu-tunggu kehadirannya oleh para peserta Seminar maupun pemerhati kegiatan geomatika lainnya yang tidak sempat hadir pada acara Seminar Nasional tersebut.

Terima kasih disampaikan kepada Panitia Seminar Nasional Geomatika 2019, para *reviewer* dan para Penulis yang telah melakukan review dan perbaikan terhadap makalahnya, sehingga akhirnya dapat dipublikasikan melalui prosiding online ini. Semoga kegiatan ini dapat terus dilanjutkan pada tahun-tahun mendatang dan menyajikan makalah-makalah berkualitas yang dapat dijadikan referensi pada kegiatan geomatika secara umum.

Cibinong, Desember 2020

Kepala Pusat Penelitian, Promosi dan  
Kerja Sama



Wiwin Ambarwulan

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# **DEVELOPMENT OF HIGHWAY (TOLL ROAD) GEODATABASE IN JAVA ISLAND REGION**

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## **ABSTRACT**

Highway (Toll Road) is a means of transportation free land routes has a role government programs in the fields of economy, socio-culture, and the environment so that there is a balance and equal distribution of development between regions. For this reason, technology is needed that is able to manage all data and information related to highway to become an integrated system. Geographical Information Systems (GIS) are used to integrate all data and information. Geodatabase is a database system that is able to store, manage, and display spatial data or information (vector and raster) and non-spatial integrated. This research was conducted to identify what data to use, design, and build the highway (toll road) geodatabase. The methodology used the construction of the geodatabase was preparation, identification to elements of data needed in the manufacture the geodatabase, adjustments to highway (toll road) laws, normalization of data, data collection, database design, geodatabase creation, and geodatabase model. The final results of this study are data collection and normalization of news 65 data derived from regulations, policies, and technical guidelines. The data generated consists of spatial data and attributes related to the toll road, which then the data generated is divided into 3 data sources, namely primary, thematic and complementary data, then a Geodatabase design that includes conceptual, logical and appropriate design in accordance with the Geographic Elements Catalog Indonesia (KUGI) version 5.

**Keywords:** Highway (Toll Road) , SIG, Geodatabase, KUGI

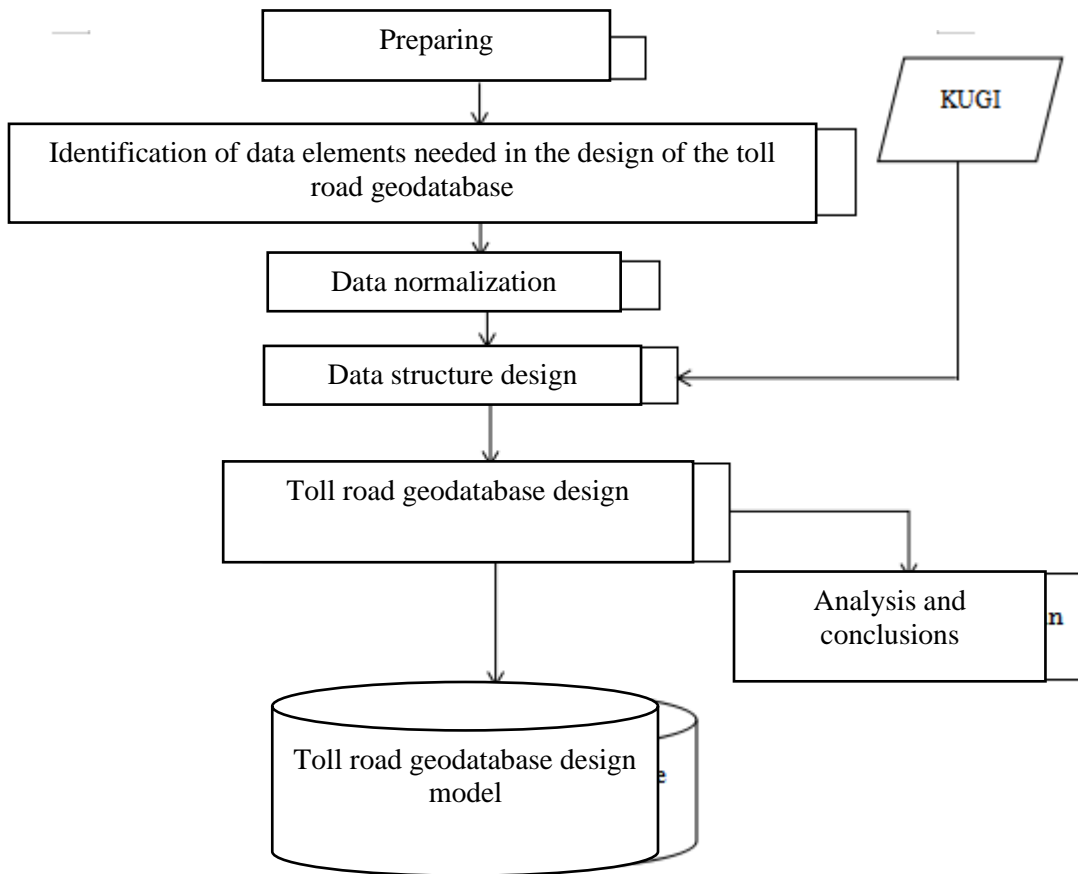
## **INTRODUCTION**

Toll roads are one of the vital facilities needed to realize equitable development and for regional development. The construction of toll roads is carried out to facilitate traffic in developing regions, increase the effectiveness and efficiency of goods and services distribution services to support increased economic growth, ease the burden on Government funds through the participation of road users and improve the distribution of development and equity outcomes (law number 38 of 2004 article 43 paragraph 1). Based on the Republic of Indonesia Presidential Regulation No. 15 of 2005 concerning toll roads contained in article 5, that toll roads must have a high level of service and comfort, including toll roads that must be equipped with crossing facilities such as bridges or tunnels and at places that endanger users toll roads must be accompanied by strengths and structures that can absorb the impact energy of vehicles, toll roads must also be equipped with road markings, and rest areas. By considering several levels of service that are regulated in the legislation regarding toll roads, a storage is needed to integrate data about toll roads properly. To facilitate data exchange, especially toll roads, using geographic information requires a common understanding related to the representation of geographical data used to distinguish between elements and attributes. Geographic Information System (GIS) is a computer system used to display and analyze data spatial or spatial (Shekbar & Chawla, 2003). In a GIS there is a database that has a georeference or also called a Geodatabase. Geodatabase is a database system that is able to store, manage, and display spatial data (information and raster) and non-spatial integrated (Plugge E, 2010). Geodatabase consists of 3 components, namely client, server and database. Client is an application for displaying, editing or analyzing spatial data. The second component is the server that is used to manage the relationship between the client and the database to be accessed by many people at the same time (ESRI, 2004). In research on the design of the Geodatabase masterplan, several stages are performed, namely identifying, designing, and designing a Geodatabase used for the needs of toll road users. The purpose of this research is what data is needed in designing the toll road geodatabase and also the toll road geodatabase.



**METHOD**

The research flow or methodology was carried out in several stages, namely, the preparations collected, and materials related to the study of literature, the stage of gathering the aspects needed in making geodatabases, toll roads, including the activities of searching, finding, and updating what was needed to making toll road geodatabases, managing spatial data and attribute data, designing basic data, and making toll road geodatabases. The research flow can be shown in **Figure 1**.



**Figure 1.** Research flow chart.

*Preparation*

In the preparation stage of the research carried out includes the preparation of tools and materials to be used, and the study of literature. Preparation of tools and materials used for the manufacture of Toll Road Geodatabases, namely hardware and software equipment. At this stage a literature review is also carried out based on the laws and regulations related to toll roads (laws, government regulations, ministerial regulations, decisions of toll road management bodies, research technical guidelines). Aims to increase the knowledge and references of writers to collect, study sources or references relating to the research theme, which are taken from books and journals on toll roads, databases of geographic information systems and matters relating to research.

*Data processing*

Homecoming data processing includes data collection activities, data identification, normalization, and geodatabase design.

*Data Identification*

At this stage, the activity carried out is to determine and identify what data will be needed to build a Development of highway (toll road) Geodatabase in Java Island region. Based on a review

of the laws and regulations relating to toll roads that apply in Indonesia, the amount of data obtained from each statutory regulation required on the Java Road Toll Road Geodatabase is as follows **Table 1**.

**Table 1.** Data Identification

Number	Regulation	Data	Amount of data
1	Republic of Indonesia Government Regulation Number 15 of 2005 concerning Toll Roads.	<ul style="list-style-type: none"> <li>➤ Toll Roads</li> <li>➤ Rest Area</li> <li>➤ Space belongs to the road</li> <li>➤ Administrative limits</li> <li>➤ Bridges</li> <li>➤ Traffic signs</li> <li>➤ Toll gate</li> <li>➤ Toll rates</li> <li>➤ Gas stasion</li> <li>➤ Toll road</li> <li>➤ Hospital</li> </ul>	11
2	Government Regulation of the Republic of Indonesia Number 44 of 2009 concerning Amendment to Government Regulation Number 15 of 2005.	<ul style="list-style-type: none"> <li>➤ Toll Roads</li> <li>➤ Rest Area</li> <li>➤ Space belongs to the road</li> <li>➤ Administrative limits</li> <li>➤ Bridges</li> <li>➤ Traffic signs</li> <li>➤ Toll gate</li> <li>➤ Toll rates</li> <li>➤ Gas stasion</li> <li>➤ Toll road</li> <li>➤ Hospital</li> </ul>	11
3	Minister of Public Works Regulation No.27 of 2008 concerning amendments to Ministerial Regulation No. 295 in 2005.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Toll rates</li> <li>➤ Ruas jalan tol</li> <li>➤ Payment method</li> </ul>	4
4	Minister of Public Works Regulation No.295 of 2005 concerning Toll Road Regulatory Agency.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Toll rates</li> <li>➤ Ruas jalan tol</li> <li>➤ Payment method</li> </ul>	4
5	Minister of Public Works Regulation No.392 of 2005 concerning Toll Road Service Standards.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Toll rates</li> <li>➤ Ruas jalan tol</li> <li>➤ Payment method</li> <li>➤ Hospital</li> </ul>	5
6	Decree of the Toll Road Processing Agency No. 3 of 2009 concerning Procedures for Licensing for the Implementation of Rest Areas and Toll Road Services	<ul style="list-style-type: none"> <li>➤ Rest area</li> </ul>	1
7	Decree of the Head of the Processing Agency. Toll Road No. 3 of 2006 concerning Service Guidelines and Assessment of Toll Road Service Standards.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Toll roads</li> <li>➤ Toll gate</li> <li>➤ Traffic signs</li> <li>➤ Space belongs to the road</li> <li>➤ DEM point</li> <li>➤ Hospital</li> </ul>	7
8	Minister of Settlement and Regional Infrastructure Decree No. 353 of 2001 concerning Technical Provisions, Procedures for	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Space belongs to the road</li> <li>➤ Traffic signs</li> </ul>	3

Number	Regulation	Data	Amount of data
	Construction and Maintenance of Toll Roads.		
9	Minister of Settlement and Regional Infrastructure Decree No. 354 of 2001 concerning Toll Road Operations	<ul style="list-style-type: none"> <li>➤ Rest area</li> <li>➤ Payment method</li> <li>➤ Toll gate</li> </ul>	3
10	Technical Guidelines for Research, Development and Empowerment in the field of Toll Road No. 1 of 2007.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Space belongs to the road</li> </ul>	2
11	Technical Guidelines for Research, Development and Empowerment in the field of Toll Road No. 2 of 2007.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Traffic signs</li> <li>➤ Bridges</li> <li>➤ Rest area</li> </ul>	4
12	Minister of Public Worker's Decree No. 370 of 2007 concerning the Determination of the Type of Motorized Vehicle Goals on Operating Toll Roads and the Amount of Toll Rates on Several Toll Roads.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Toll rates</li> </ul>	2
13	Toll Road Processing Agency Decree No. 16 of 2008 concerning the Master Plan for Rest and Services on Toll Roads.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Rest area</li> </ul>	2
14	Minister of Public Worker's Decree No. 16 of 2014 concerning Toll Road Minimum Service Standards.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Rest area</li> <li>➤ DEM point</li> </ul>	3
15	Minister of Public Workers and Public Housing Regulation No. 43 of 2015 concerning the Toll Road Regulatory Agency.	<ul style="list-style-type: none"> <li>➤ Toll road</li> <li>➤ Rest area</li> <li>➤ Space belongs to the road</li> </ul>	3

### Data normalization

After identifying the data, it turns out that from each of the laws and regulations there is redundant data, so it is necessary to normalize the data. Normalization aims to eliminate redundant data, reduce data complexity, and simplify the modification process. Normalization is done by checking or checking carefully the data identified. If the same data is found or has the same purpose, then the data is generalized into a data that represents these duplicate data (Maryam, 2015). From this study the amount of data obtained based on the laws and regulations used was 65 data. After making the normalization process into 16 data along with data and data types.

**Table 2.** Data normalization

Number	Data	Custodian	Data type
1	Provincial boundary	Geospatial Information Agency	Spatial
2	District boundary	Geospatial Information Agency	Spatial
3	Sub-District boundary	Geospatial Information Agency	Spatial

Number	Data	Custodian	Data type
4	Village Boundary	Geospatial Information Agency	Spatial
5	Toll Road	Binamarga Office	Spatial
6	DEM point	Geospatial Information Agency	Spatial
7	Bridges	Department of Transportation	Spatial
8	Rest Area	PT.Jasa Marga	Spatial
9	Gas Stasion	Geospatial Information Agency	Spatial
10	Hospital	Geospatial Information Agency	Spatial
11	Toll Gate	PT. Jasa Marga	Spatial
12	Traffic Signs	Ministry of Public Workers and Public Housing	Spatial
13	Payment Method	PT. Jasa Marga	Atribute
14	Toll Rates	PT. Jasa Marga	Atribute
15	Toll Roads	PT. Jasa Marga	Spatial
16	Space belongs to the road	PT. Jasa Marga	Atribute

## RESULTS AND ANALYSIS

### *Result*

The results of this research are the design of the toll road geodatabase which is identified based on the laws and regulations related to the Java toll road, which will then be adjusted to the Indonesian Geographic Elements Catalog (KUGI). toll road geodatabase design, data normalization, database design and finally is the making of a Java highway toll road geodatabase model.

### *Analysis*

Based on the results of research that has been done, it can be analyzed the design of toll road geodatabases, which is related to the literature used, the design of toll road geodatabases, geodatabase structures according to KUGI, and the planning of toll road geodatabase data structures.

### *Reference Analysis in the Data Identification and Normalization Process*

In designing the toll road Geodatabase using regulations, policies, related to toll roads and reports on the results of research relating to toll roads. Of all the regulations, policies and regulations regarding toll roads, there are 15 regulations, rules and policies regarding toll roads. From the identification process, 65 data are obtained about toll roads which are then normalized so that there are no double / duplicate data, so that 16 data are used in the toll road geodatabase design process. In the geodatabase design process the data structure determines basic data, thematic data and supplementary data. In the database design process, there are difficulties in determining the custodian and determining the attributes (fields) for the contents of the toll road entity data. Because there are no SNI guidelines for making geodatabases or technical workmanship or standard rules in explaining the completeness of attributes in geodatabase design. So in this study, the process carried out in database design and data structure is by looking at existing references such as KUGI (Catalog of Indonesian Geographic Elements) Version 5.

**Table 5.** Normalization and identification result data.

Number	Data	Custodian	Data type
1	Provincial boundary	Geospatial Information Agency	Spatial
2	District boundary	Geospatial Information Agency	Spatial
3	Sub-District boundary	Geospatial Information Agency	Spatial
4	Village Boundary	Geospatial Information Agency	Spatial
5	Toll Road	Binamarga Office	Spatial
6	DEM point	Geospatial Information Agency	Spatial
7	Bridges	Department of Transportation	Spatial
8	Rest Area	PT.Jasa Marga	Spatial
9	Gas Stasion	Geospatial Information Agency	Spatial
10	Hospital	Geospatial Information Agency	Spatial
11	Toll Gate	PT. Jasa Marga	Spatial
12	Traffic Signs	Ministry of Public Workers and Public Housing	Spatial
13	Payment Method	PT. Jasa Marga	Atribute
14	Toll Rates	PT. Jasa Marga	Atribute
15	Toll Roads	PT. Jasa Marga	Spatial
16	Space belongs to the road	PT. Jasa Marga	Atribute

### *Analysis of Toll Road Geodatabase Design*

In the process of designing the Geodatabase, the stages of conceptual, logical and physical database design are carried out. In designing the conceptual database, determining the entities and determining the Primary Key (PK) and Foreign Key (FK), in the conceptual database design of the design data. Geodatabase of toll roads obtained 16 data including Provincial Border, Regency Boundary, District Boundary, Village Boundary, Toll Road, Dem Point, Bridge, Rest Area, Gas Station, Hospital, Payment Method, Toll Gate, Toll Road, Toll Road, Traffic Sign. Toll Roads, and Toll Road Space, of the 15 data obtained, there are 3 data used as attributes, namely Payment Method, Toll Road Rates, and Road Space. Logical database design process, at this stage the process of determining the relationship one to one (1: 1), one-to-many relationships (1: M), and many-to-many relationships (M: N). Finally, the process of designing a physical database, at this stage, the attributes (fields) are made. The difficulty in carrying out these processes is determining the overall code and naming of each entity and attributes that must be adapted to the Indonesian Geographic Elements Catalog (KUGI).

### *Elemental Analysis of Indonesian Geographic Elements Catalog Principle Version 5*

The analysis was carried out in making the data structure referring to the Indonesian Geographic Elements Catalog Version 5, there were 14 categories namely Spatial Reference, Boundary, Transportation, Hydrographic, Hypography, vegetation, built environment, utilities, soil geology, topology, cadastral, disaster and special datasets, but in the design of the toll road geodatabase, only 4 categories were used, including the area boundaries consisting of Provincial Boundaries, Regency Boundaries, District Boundaries, Village Boundaries, and then Hipsography, namely DEM points, land transportation and utilities, several entities not contained in the 14 category element, it will be given a special definition (regulated in Book 1 of KUGI Principle 5 sub-article 4.3).

Toll road geodatabase design model

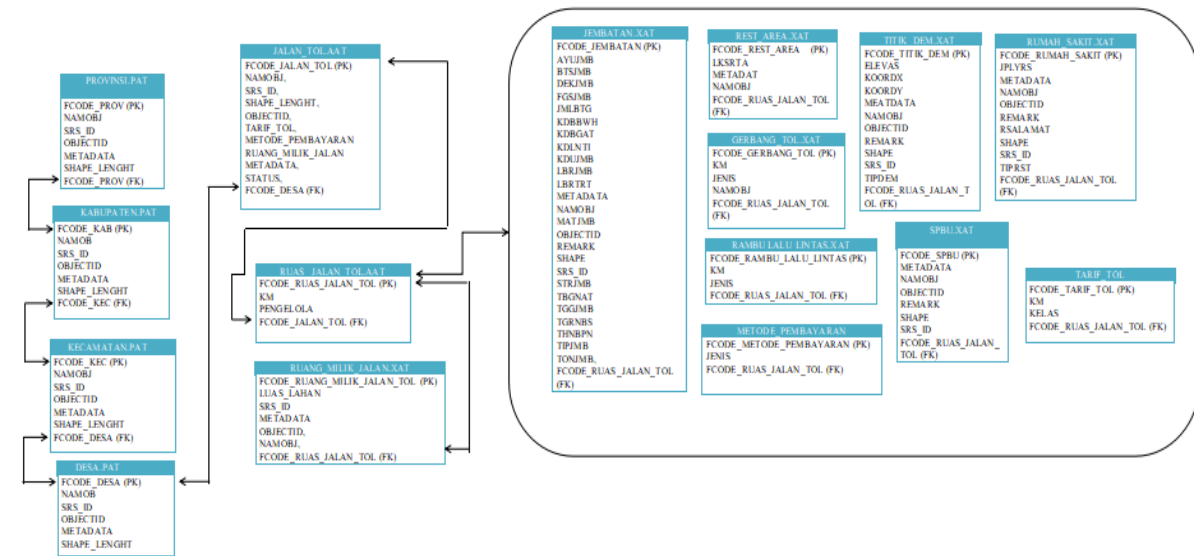


Figure 2. Toll road geodatabase design model.

CONCLUSION

Based on the results and analysis of the research conducted, several conclusions can be drawn. The following conclusions can be drawn: Types of data needed to build a toll road geodatabase are data identified from the review of laws and regulations relating to the development of a Java toll road geodatabase totaling 16 data contained in basic, thematic and complementary data, including: Basic Data (Provincial Border, Regency Boundary, District Boundary, Village Boundary and DEM Points), Thematic Data (Toll Roads, Bridges, Hospitals, Rest Areas, Gas Stations, Traffic Signs, Toll Gates, Toll Roads), and Data Complementary namely Payment Methods, Toll Road Rates and Property Space. Geodatabase design is carried out with the stages of designing conceptual models, logical models, and fiscal models that aim to determine the relationship between entities from the data obtained from the process of data identification and normalization. The results of the geodatabase design may not have been all the data obtained in accordance with the Basic Principles of the Indonesian Geographic Elements Catalog Version 5 which is guided by law number 4 of 2011 regarding geospatial information, in the geodatabase design of this toll road, there are only 4 out of 15 data that are suitable with KUGI, namely gas stations, DEM points, hospitals and bridges. Therefore, for some data that is not yet contained in KUGI, naming will be done based on KUGI rules in accordance with SNI ISO 19110: 2015 regarding the addition of attribute elements.

Based on the results of the construction of the toll road geodatabase specifically the Java lane, a special assessment is needed in determining the custodian / Metadata (data owner), which is obtained from regulations, policies and technical instructions related to the design of the toll road, so it is expected that the next researcher can improve data identification and toll road attributes that are guided by the Indonesian Geographic Elements Catalog (KUGI), so that the results of data identification and attributes can be further refined.

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