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# Mapping and Analiyzing The Level of Road Damage Using Geographic Information System Applications (Case Study : Srandakan-Poncosari-Pandansimo Road, Srandakan Sub-District, Bantul, Special Region of Yogyakarta)

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**Abstrack:** The Srandakan-Poncosari-Pandansimo road section, Srandakan District, Bantul Regency, Yogyakarta Special Region Province is a road that connects Bantul City with tourism sites. Based on its function, the Srandakan-Poncosari-Pandansimo road section is included in the Provincial road category. In order for the road to be used properly, the road must be made and designed and maintained in accordance with the requirements set by the government. Road pavement is a layer of pavement that lies between the subgrade and the wheels of the vehicle. There are three types of pavement, namely flexible, rigid and composite or combined pavement. Geographic Information System is a spatial information technology system that is commonly used today. In general, GIS works based on five components, namely hardware, software, data, people, and methods. The selection of data methods using GIS because of the ability of GIS programs that can answer the needs of efficient information systems and are able to process data with complex structures and geographic (spatial) based. GIS is able to store, analyze, present spatial data and atri but data (tables), able to answer spatial questions (how long, wide etc.) so as to provide more informative data than other computer-based information systems and can help make decisions quickly and accurately. In this study, the percentage of road damage is 3.110345%. The types of damage on the Srandakan-Poncosari-Pandansimo road section are longitudinal cracks, random cracks, alligator cracks, potholes, collapse or deformation and patches.

**Keywords:** Road Pavement, Geographic Information System (GIS), percentage of road damage.

## INTRODUCTION

The Srandakan-Poncosari-Pandansimo road section, Srandakan District, Bantul Regency, Yogyakarta Special Region Province is a road that connects Bantul city with tourism

sites. Based on its function, the Srandakan-Poncosari-Pandansimo road section is included in the Provincial road category. Roads are a means of land transportation that has a very important role in supporting the development sector, especially for continuity in the distribution of goods and services, and supporting the rate of economic growth (Directorate General of Highways, 1995). Along with the increasing need for transportation facilities that can serve traffic from one place to another. In order for the road to be used properly, it must be made, designed and maintained in accordance with the requirements set by the government. One of the steps in road construction and design is pavement with good materials (Peraturan Pemerintah Republik Indonesia No. 34, 2006). Road pavement is a layer of pavement located between the subgrade and the wheels of the vehicle, which functions to provide services to transportation facilities, and during its service period it is expected that no significant damage occurs (Department of Public Works, 1992). There are three types of pavement, namely flexible, rigid and composite or combined pavement (Directorate General of Highways, 1990). The next step that can be taken in the road maintenance system is to use spatial information technology. Geographic Information System (GIS) is a spatial information technology system that is commonly used today. Geographic Information System (English: Geographic Information System abbreviated as GIS) is a specialized information system that manages data that has spatial information, or in a narrower sense is a computer system that has the ability to build, store, manage and display geographic information, for example data identified according to its location, in a database (Barus, 2000). The main purpose of utilizing Geographic Information Systems is to make it easier to obtain information that has been processed and stored as attributes of a location or object (Prahasta, 2002). The use of maps for fast and effective communication of data and information makes GIS a powerful tool for maintenance purposes above. The three main elements in GIS are system, information and geographic (Burrough, 1986). The research have aims to make it easier to analyze road damage that occurs in Srandakan District, knowing the road conditions and can find out how to model maps on roads using geographic information system applications.

## METHOD

### Place and Time of Research

The qualification of road damage using a geodatabase-based Geographic Information System was carried out on the Srandakan-Poncosari-Pandansimo road section, Bantul Regency, Yogyakarta Special Region Province which is a provincial road with a collector road classification. The implementation time of this research began from the submission of the proposal until the writing of the research results was completed. That is, starting from February, March, and continued in May 2017. The equipment used in the research is as follows; camera, research form, tape measure 50 m and 5 m, tripod, GPS, stationery.

**Table 1. The Boundaries of Srandakan Sub-District**

| Condition | Description |
|---|---|
| North Side | Kulon Progo |
| East Side | Pandak |
| South Side | South Coast |
| West Side | Kulon Progo |
| Electricity Capacity | 1.800 watts |
| Distance of Sub-District Government Center | District Capital : 12 km<br>Provincial Capital : 23 km |

### Data Collection Methods

In this study, the data collected is primary data obtained after making direct observations in the field, which includes primary data (Sukirman, 1999):

1. Damage data - pavement defects.
2. Drawings or photographs of types of road defects.

3. Length, width of road section
4. Road surface condition
5. Road conditions

**Table 2. Road data**

| Condition | Description |
|---|---|
| Road Class | Provincial Road |
| Road Function | Collector |
| Road under review | Main Road of Srandakan Sub-district |
| Pavement Type | Flexural Pavement |
| Road Section Length | 19 km |
| Road Section Width | 6 m |
| Width per Lane | 3 m |
| Road Type | Divided road, 1/2T (one lane two-way) |
| Pavement Condition | Road pavement is damaged |
| Drainage | Existing. 1 m wide |
| Road Shoulde | None |
| Sidewalks | None |

## RESULT AND DISCUSSION

The results of the survey or observation of damage to the Srandakan-Poncosari-Pandansimo Road Section illustrate the level of road damage that is very dominant. Analysis of the level of damage using the Bina Marga Method.

### Percentage Value of Road Damage

Calculate the percentage of damage to the Srandakan-Poncosari-Pandansimo road section (Directorate General of Highways, 1997) as follows:

$$a = A \div (P \times L) \times 100\% \quad (1)$$

With : a = percentage damage (%)

A = Area of damage ($m^2$)

P = Road Length (m)

L = Road width (m)

Calculation of percentage value ($a$) of road damage on the Srandakan-Poncosari-Pandansimo section, Srandakan District, Bantul Regency, Yogyakarta Special Region Province are

$$a = 3545.793 \div (19000 \times 6) \times 100\% \quad (2)$$
$$= 3.110345\ \%$$

**Table 3. Percentage of Damage**

| Asphalt Road Condition | Damage Rate (%) |
|---|---|
| Good | 0-5 |
| Medium | 6-20 |
| Broken | 21-30 |
| Severly Damaged | >30 |

Based on the results of the above calculations using equation (1) which shows the level of damage as a percentage of the Srandakan-Poncosari-Pandansimo road section, Srandakan District, Bantul Regency, Yogyakarta Special Region Province, the damage is obtained with the type of road section condition is good. However, looking at the existing damage, there is still a need for evaluation and improvement plans because it is seen that the road is an access to distribution and facilities that are always used by the community.

### ArcGIS

ArcGIS 10.3 consists of ArcCatalog, ArcMap, ArcScene, and ArcGlobe. Where the functions of each are as follows: ArcCatalog is the same as the explore window (create folders, display images) and also create layers or shapefiles, ArcMap is the place to create/display/digitize/view layouts or analysis layers, Arcscene is a three-dimensional view and ArcGlobe is google Earth (Dulbahri, 1993). There are generally 2 kinds of GIS data, namely spatial data (images) and attribute data (tables). ArcGIS data sources can be obtained from bibs (map scans), Gps (global position system), images, and GIS support software. Coordinates can be said to be an address or position that is translated into numbers. There are two types of coordinates that are often used in Indonesia, namely geographic coordinates and UTM (universal translator mercator) coordinates.

**GIS Database Creation**

The following are the steps for preparing the road damage map (Harmon, 2003) in the Srandakan-PoncosariPandansimo road section, Srandakan District, Bantul Regency, Yogyakarta Special Region Province.

1. Determine the coordinate points, and define the damage that occurs at these coordinates and measure the length and width of damage to each road damage along the Srandakan-Poncosari-Pandansimo road section, Srandakan District, Bantul Regency, Yogyakarta Special Region Province. After the data has been obtained, then compile the data using excel.
2. Then start opening the ArcGIS 10.3 application. windows → all programs → click ArcGIS 10.3 then click 1 time and wait a moment until ArcGIS 10.3 can open → cancel. Can be seen in the picture.
3. After canceling, the ArcGIS 10.3 display will be empty.
4. After ArcGIS 10.3 is empty, the next step is to enter the coordinate points into ArcGIS 10.3 by clicking file → add data → add xy data → select folder → click excel / coordinate points that are examined → add → add → ok.
5. After the coordinate point data in excel can be displayed with the ArcGIS 10.3 application, the coordinate points in excel will form a road route that has damage according to the reality in the field. Can be seen in figure 1.

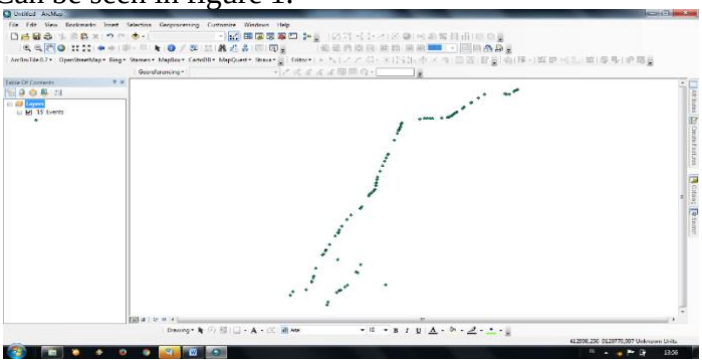

**Figure 1. Point Coordinates Successfully Displayed**

6. After the coordinate points in excel successfully appear in the ArcGIS 10.3 application, the next step is to layer the data points right-click → data → Export data click → select the storage folder (TA) → save → Ok.
7. After the coordinate points that have been explored the data has been saved into the folder that has been selected then the next step is the coordinate point layer → right click → Propertis → labels → select the label field road conditions → tick label features in this layer → ok, and a description of the damage at the coordinate point will come out.
8. After the road damage information at each coordinate point has been successfully displayed, it continues by calling all the attributes that will be used, including the Road, river, administration, and land use attributes.

9. After everything has been called, do the blinding according to the area under study by clicking rectangle.
10. After the folder name has been determined, click geoprocessing → clip. Similarly, do the same steps with the roads, land use, and administration folders, this step aims to cut out areas that are not needed. Can be seen in figure 2.

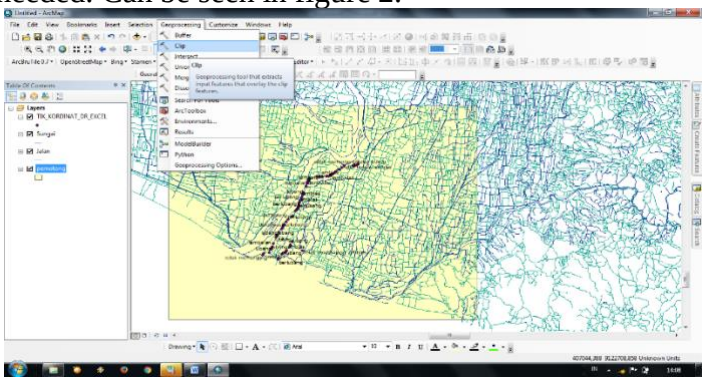

Figure 2. Blocked Image

11. After all the required data has been geoprocessed, then cut the unused area (outside the block) by right-clicking → remove, namely the data files for roads, rivers, land use, and administrative boundaries until we get the area under study. Can be seen in figure 3.

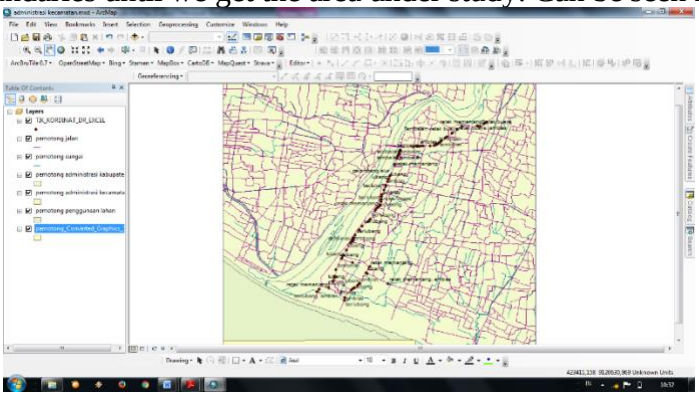

Figure 3. Files that have been removed

12. After all the required data has been geoprocessed, then cut the unused area (outside the block) by right-clicking → remove, namely the data files for roads, rivers, land use, and administrative boundaries until we get the area under study. Can be seen in figure 4.3
13. Indicate the path as follows; layer → coordinate point from excel → view → right click → data frame view → data frame → right click → properties → data frame → ok → catalog → click folder → new → shapefile → create damage folder name → feature type replace polygon → edit → ok → continue → click coordinate point from excel → right click → open attribute table → lengeth → lengeth → click on coordinate point → connect line from one coordinate to another if it has formed the next damage → right click → finish sketch.
14. Road damage → right click → open attribute table → right click on the table → add field → name is filled with damage → type is replaced with text → ok → foled properties are filled with the number 150 → ok, → editing → start editing → click on the damage folder → ok → continue → stop editing → click on the catalog → ok → connect to the next point → save as and so on until all road damage can be drawn.
15. Next is to create a header on the road damage map by clicking view → clicking layout view → clicking file → page and print setup left click on the image → right click → click properties → click on frame 0k → coordinate system, double click → projected

coordinate systems → ok → UTM double click → find WGS 1984 → shoutem hamisphephere → WGS 1984 UTM Zone 49S double click → ok → ok → click grids → click new grid → Ok → next → next → finish → ok.

16. After finishing making the header on the map, the header is given attributes so that the map to be presented looks more attractive. Here are the steps for giving attributes to the map, namely layout or print display. To create a layout, click view → select layout view, the map layout and layout toolbar will appear, → set the paper size and orientation of the page and print setup file → grids coordinate → from view → right-click data frame properties → select data frame properties → click grids select new grids → next → next next → finish → title clickake A ( ) north arrow (direction), → set scale → automatically replaced fixed scale legend or attribute select from the insert toolbar. Can be seen in figure 4.

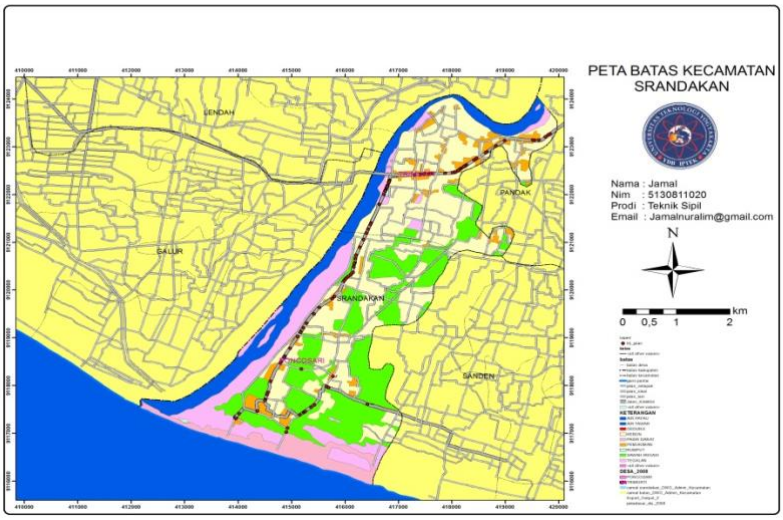


**Figure 4. Finished Map**

## CONCLUSION

From the research data and data analysis that has been carried out, the following conclusions can be drawn:

1. The types of road damage found on the Srandakan-Poncosari-Pandansimo road section based on the observation of each coordinate point and using the Bina Marga method are as follows: longitudinal cracks, random cracks, crocodile cracks, holes, collapse, wavy or deformation and patches.
2. The causes of damage to the Srandakan-Poncosari-Pandansimo road section based on the analysis of survey observations carried out are overloading, poor pavement materials and materials, unstable soil conditions and lack of maintenance or road maintenance.
3. The results of the analysis and evaluation of road damage conditions on the Srandakan-Poncosari-Pandansimo road section are 3.110345%. And the percentage of road damage according to table 4.2 obtained damage with the type of road section condition is good. But looking at the state of the field, it is still necessary to repair and maintain the road section, by improving the subgrade by forming the soil and compaction of the soil, then maintaining the layers of flexible pavement.

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