Long Segment

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Comparison Analysis Between Traditional and Long Segment Contracts on National Road Preservation Activities in Indonesia

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***Abstract*—National road preservation activities in Indonesia are usually carried out using a traditional approach system, namely in-house system and contract system with a design-bid-build (DBB) approach. An alternative contract method to improve the quality of roads is the long segment contract. Its definition is carrying out road preservation activities in one continuous segment with the aim to obtain good road conditions for all segments. This study aims to compare the performance under traditional approaches and long segment contracts. Road performance is expressed in functional performance terminology and uses the International roughness index (IRI) indicator. The research was conducted on the outer urban road of Palembang - Indralaya intersection - Meranjat which is part of the national road section in the Province of South Sumatra, Indonesia. Results showed that the road performance contracted with traditional approaches was better than that of long segment ones. This was not expected and was probably due to the lack of understanding of the parties involved in the long segment contract to the principles of fulfilling road service performance. The contractors are not interested in carrying out routine road maintenance projects because the value of the work is small and there is a lack of experience regarding routine maintenance.**

Keywords-traditional contracts; long segment contracts; IRI values

I. INTRODUCTION

Road preservation is generally carried out in traditional approach systems, namely in-house and contract system with DBB delivery approach [1]. The contract is an integral part of the project delivery. In order to improve road quality, an alternative contract method is required which will include considerations of performance aspects, such as guaranteed contracts, performance-based contracts (PBC), and long road maintenance contracts (long segment maintenance contracts) or long segment contracts. There are difficulties in implementing PBC pilot projects in Indonesia. The challenges of implementing PBC start from the procurement stage to implementation [2, 3]. The Supreme Audit Agency (BPK) recommended that PBC implementation should be reviewed, because BPK cannot measure the effectiveness of using public funds based on performance measures as required in PBC. BPK always applies a volume-based measurement system for all uses of these public funds. Consequently, applying long segment contracts is an alternative way to overcome these difficulties. Traditional approaches with both in-house and contract-based systems in the implementation of road construction have not been oriented to better cost, time and project quality [4]. Authors in [5] stated that contracts with traditional approaches have some difficulties in effectively managing quality, time and costs. Meanwhile, poor work quality will have an impact on the road service life which will become shorter and will result in high road maintenance costs [6]. The weakness of traditional contracts is that they are not oriented towards the aspects of road performance and cost, concerning their lack of efficiency on road maintenance costs. This condition favors the implementation of long segment contracts since they are oriented towards those two aspects. In 2016, long segment contracts started to be implemented for road preservation on several national roads in Indonesia. The aim was to obtain good road conditions for all segments. Based on the background, a problem was formulated on comparing the performance of roads on preservation activities between traditional approaches and long segment contracts. The scope of the analysis was based on the assessment of the functional conditions of the road using the IRI. The results of preservation activities under traditional approaches and long segment contracts were compared. As a final outcome, challenges and opportunities for the implementation of long segment contracts occurred as a consideration for road managers in road preservation programs.

II. LITERATURE REVIEW

A. Road Maintenance Contract

Road maintenance contract is one of the contract forms in the implementation of construction work. Based on the Government Regulation of the Republic of Indonesia Number 29 of 2000 on the implementation of construction services, the construction work contract is divided into three forms, namely compensation types, duration of construction work, and method of payment. The contract is inseparable from its project delivery. Project delivery method is a project implementation

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method approach designed to define relationships, roles and responsibilities of the parties involved in each stage of the project to achieve the objectives.

1) Traditional Road Maintenance Contracts

In road maintenance, there are two traditional approaches, namely in-house system and contract system with a DBB delivery approach [1]. In-house is applied for routine maintenance work, while the input-based contract system with DBB delivery approach or traditional contract system is applied for periodic maintenance work and road improvement. Authors in [7] state that traditional contract is a form of construction work contract based on the division of tasks aspects. The contract agency assigns the contractor to carry out one of these jobs: planning, supervision, or implementation. In-house is a form of construction work contract based on the aspect of job division. However in-house is not a form of contract since it is the implementation of work planned, carried out, and self-monitored without buying it up to contractor [7]. The weakness of traditional approach systems is that they have some difficulties in effectively managing quality, time and costs. Poor work quality will have an impact on the road service life which will become shorter and results in high road maintenance costs.

2) Long Segment Contract

One way to overcome the problem of low road quality is the application of alternative contracting methods, ones that consider the performance aspects of the work results. The alternative contract methods include guaranteed contracts, PBC, and long segment contracts. Based on the Circular of the Directorate General of Bina Marga Number 09/SE/Db/2015 on the Implementation of Procurement Process and Work on Road Preservation in Long Segment, the definition of long segment is road preservation activities in one continuous segment (can be more than one roads) which is carried out with the aim of obtaining the same road conditions, namely a good road condition and meeting standards throughout the segments (the standard is in accordance with [8]. Meanwhile, the scope of activities (output) of long segment work includes widening, reconstruction, rehabilitation, and maintenance of roads. Based on the delivery approach, long segment contracts are also DBB contracts like traditional contracts, yet have performance as the main aspect and maintenance as the scope of activities.

B. Road Pavement Performance

Pavement performance is a function of the relative ability of pavement to serve traffic in a certain period. The performance of pavement is determined on the requirements of road functional conditions and structural conditions. The structural conditions of the road begin with the condition of the road structural layer and continue to the lower layer, consisting of the road surface layer, upper foundation layer, bottom foundation layer and subgrade. Structural pavement performance shows pavement carrying capacity. The measurements use Benkelman beam or falling weight deflectometer (FWD) test equipment. The functional condition of the road is the service condition of the road pavement surface for road users in the form of roughness, road surface unevenness that provides comfort, and security for traffic. Functional pavement performance is expressed in surface index (SI) or present serviceability index (PSI), surface distress index (SDI), road condition index (RCI), and IRI. This study compared the pavement performance based on the assessment of the functional conditions of the road in the form of IRI values. IRI value is an international index that shows the size describing the value of surface inequality indicated as the cumulative length of surface fluctuation per unit length. IRI is expressed in meters per kilometer of the length of the road (m/km). The method for measuring road surface roughness used the National Association of Australian State Road Authorities (NAASRA). The relationship between the IRI values and the criteria for road conditions on asphalt roads, panmac roads and land /gravel roads is given in Table I.

TABLE I. CRITERIA FOR ROAD CONDITIONS BASED ON PAVEMENT TYPE

Condition Criteria	IRI Value Based on Pavement Type		
	Asphalt Road	Penmac Road	Land /Gravel Road
Good	IRI≤4	IRI≤8	IRI≤10
Medium	IRI>4 and IRI≤8	IRI>8 and IRI≤10	IRI>10 and IRI≤12
Minor Damaged	IRI>8 and IRI≤12	IRI>10 and IRI≤12	IRI>12 and IRI≤16
Heavy Damaged	IRI>12	IRI>12	IRI>16

III. RESEARCH METHODOLOGY

A. Research Location

This research was conducted in South Sumatra Province, one of the largest provinces in Indonesia and the largest in Sumatra. In Ogan Ilir District, it focused on National Road preservation activities conducted by the Balai Besar Pelaksanaan Jalan Nasional V Palembang, covering the outer urban road of Palembang-Indralaya intersection-Meranjat with the segment numbers of 005 and 007. The total length of the sections is 29.05Km consisting of the outer urban road of Palembang-Indralaya Intersection of 16.45Km and Indralaya Intersection-Meranjat which is of 12.60Km long .

B. Data Collection

The method of secondary data collection was utilized in this study. The secondary data in this study were the road functional performance data, namely the IRI value on the outer urban road of Palembang-Indralaya intersection-Meranjat from 2011 to 2017 derived from the National Road Planning and Monitoring Unit (P2JN) of South Sumatra Province. The data were the IRI results at the end of the year of road preservation. The IRI values of the traditional approaches were the result of preservation activities under these approaches from 2011 to 2015, while the IRI values that showed the functional performance of the road in the long segment contract studied were the results of preservation activities under long segment contracts from 2016 to 2017. The recapitulation of IRI values are provided in Table II. Regarding data processing and analysis, the performance of road pavements on the outer urban road of Palembang-Indralaya intersection-Meranjat is:

- Collecting the IRI data of 2011 to 2017, namely the IRI values per segment of 100 meters on the functional outer

urban road of Palembang-Indralaya intersection (16.45Km) and Indralaya Intersection-Meranjat (12.60Km).

- Determine the IRI values representing the IRI values of the road by averaging the IRI value per segment:

$$Avg\ IRI\ per\ segment = \frac{No.of\ IRI\ values\ per\ segment}{No.of\ segments\ (per\ 100m)} \quad (1)$$

- Comparing the average IRI values per year. Comparing the IRI values of the results of road preservation activities using traditional contracts (from 2011 to 2015) with the IRI values resulting from road preservation activities using long segment contracts (from 2016 to 2017).
- Conducting semi-structured interviews with relevant stakeholders, the owner and the contractor, to strengthen the analysis of the comparison of road pavement performance between traditional contracts and long-segment contracts so that potential benefits could be obtained in implementing long segment contracts.

TABLE II. IRI VALUE FROM 2011 UNTIL 2017

Road Segments	IRI Value						
	Year						
	2011	2012	2013	2014	2015	2016	2017
Outer urban road of Palembang-Indralaya intersection	6.39	4.51	5.01	4.84	3.35	5.05	4.74
Indralaya intersection-Meranjat	5.27	4.66	4.23	4.87	2.98	4.81	4.58

C. Data Analysis

IRI value data processing was carried out on the outer urban road of Palembang-Indralaya intersection and the road segments of Indralaya intersection–Meranjat from 2011 to 2017. IRI value data processing on the outer urban road of Palembang-Indralaya intersection was carried out per road segment. The results were then grouped based on the road conditions along the road given in Figure 1. The calculation of the Average IRI value on a road of 16.45Km with 165 segments is as follows:

$$Average\ IRI\ Value = \frac{832{,}90}{165} = 5.05$$

IV. DISCUSSION

Based on the results of data analysis, the comparison outputs of the performance of road pavement between traditional contracts and long segment contracts on outer urban road of Palembang-Indralaya intersection and road segments of Indralaya intersection–Meranjat are provided in Figures 2 and 3. The IRI values of the traditional contracts tended to decrease. In 2016, as the initial year of applying the long segment contract, the IRI values on both segments re-increased. In 2017, both IRI values decreased again.

2016 was the first year of implementing a long segment scheme and at the same year IRI values tended to increase. This is because of the lack of optimal implementation of preservation activities on the scope of long segment contract activities, especially the routine road maintenance activities.

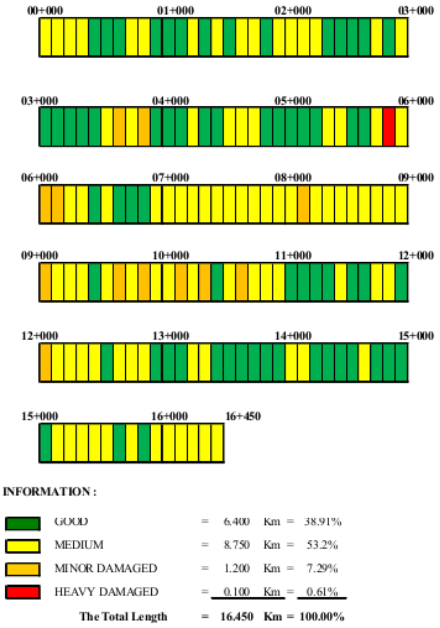

Fig. 1. Strip map of road condition based on the IRI Values on the outer urban road of palembang-Indralaya intersection in 2016

Fig. 2. IRI value comparison on outer urban road of palembang-Indralaya intersection road segments

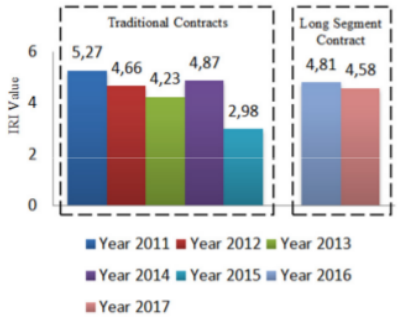

Fig. 3. IRI calue comparison on Indralaya–Meranjat road segments

There was a lack of understanding regarding to routine maintenance activities by the contractors. They prioritized works such as widening, reconstruction, rehabilitation, and reactive road activities, although fixed penalty is applied for the delay in repairing damage in the scope of routine maintenance. Routine road maintenance is that the road components (road pavement, road shoulders, drainage systems, road additions, and road equipment) are maintained at all times and are in good service conditions based on the required performance. As for routine maintenance activities such as closing sealing, patching, spot leveling, pavement edge repair, asphalt surfacing, crack repair, corrugated surface repair, and deep rutting to maintain a standard transverse slope. According to the Palembang P2JN, 2016 was the initial year for implementing long segment contract on the outer urban road of Palembang-Indralaya-Meranjat, along with the other long segment scheme applications in Indonesia. The Ministry of Public Works of the Directorate General of Bina Marga conducted modifications to the long segment contract in 2017, namely changes in payment terms for the scope of routine road maintenance activities. In 2016 the payment for the scope of routine road maintenance activities was lump sum, but in 2017 it changed to volume based for all the scopes of activities on long segment contracts.

It is expected that the contractor can prioritize road maintenance activities. This change of payment intended contractors' bid prices for routine road maintenance to be more measurable and not too low. In implementing the contracts, the payment was in accordance with the volume based to make it easy to optimize the program. If there was an addendum to the contract (work added/reduced) in the scope of routine maintenance activities, it became more flexible to shift funds. From the previous discussion, the potential benefits for implementing long segment contracts are:

1) Road Conditions are Better Maintained and the Cost of Road Maintenance is More Efficient.

The application of KBK has the opportunity to improve the quality and service of national roads through sustainable road management and maintenance, as well as saving on road maintenance costs with the value of the NPV of KBK of 70% NPV traditional contracts [9]. The implementation of KBK in the procurement of goods and services in developing countries can reduce costs and time constraints and improve procurement quality [10]. KBK generates cost reduction in a contract and improves the quality of a product or service [11]. PBC is an alternative and cost-effective solution, both reducing direct costss and indirect costs compared to traditional contracting approaches [5]. This is in line with the long segment contract, in which road damage can be quickly handled, road components can be maintained at all times, and in good service conditions to prevent continuous damage. By preventing greater road damage, the cost of road preservation activities becomes more efficient. In addition, with long contracts, the road maintenance cost segment becomes smaller because of the optimization of the cost of road management, including the cost of procurement of goods/construction services, road supervision costs, and overhead (general) road construction.

2) National Road Work Outcomes are in Accordance with the Applied Performance Indicators

Meeting the road service levels in long segment contracts is regulated in the Special Specifications Skh.1.10.a regarding the Maintenance of Road Performance and Special Specifications Skh.1.10.2 on the Maintenance of Bridge Performance. If the providers cannot meet the level of road and bridge services on the specified response time, they will be sanctioned financially in the form of payment deductions in accordance with the Special Specifications for Maintenance of Road Performance of Section Skh-1.10.a.4.3 and Special Specifications for Maintenance of Bridge Performance Skh-1.10.b.4.5. Therefore, road organizers have an extra motive to get steady road conditions throughout the segment.

3) Program Optimization in Implementing Long Segment Contracts

The long segment contract has the advantage that one contract covers four road preservation activities, namely widening, reconstruction, rehabilitation, and maintenance. Therefore, the long segment contracts are flexible and the programs can be optimized with available funds. Furthermore, after a payment is modified for the scope of routine maintenance activities to be volume based, it becomes easier to shift funds. Program optimization on long segment contracts can be carried out as follows:

- Adjustment of location of activities is effective against field conditions or field engineering results.
- Delay (holding) for damaged segments which cannot be handled.
- Decrease in time of plans for rehabilitation and or reconstruction activities.
- Transfer of funds between the scope of activities.

Given the program optimization, the road preservation activities meet the needs and the road along the segment can be maintained. The challenges in the application of the long segment contract are:

1) Lack of Experience in Long Segment Contract

The Directorate General of Bina Marga has developed a long segment contract since 2016 with 256 packages of national road preservation, 25 of those are managed by Balai Besar Pelaksanaan Jalan Nasional V Palembang (BBPJN V Palembang). According to Satker P2JN Palembang, the long segment contracts are more accountable in terms of financial administration. They can also improve maintenance standards and overcome poor in-house (direct labor-based) performance in national road maintenance. The application of long segment contracts is better than the traditional contract approach, but it has not been widely disseminated. To get a steady and uniform road condition along the integrated segment, it is expected that long segment contracts are not only applied to national roads, but also to provincial and district/city road maintenance.

2) Lack of Contractor's Understanding in Implementing Long Segment Contracts

The number of contractors having experience in KBK is limited [9, 12, 13]. It is a challenge in implementing KBK. The lack of knowledge of KBK still needs to be dealt with in order to prepare for its application. Similarly, for the implementation of long segment contracts, the lack of understanding of contractor in carrying out road maintenance activities needs to be dealt with because these activities are the main scope of long segment contracts. It is necessary to improve the contractors' quality in meeting the level of road services, and to maximize performance inspections.

V. CONCLUSION

The results of data analysis show that the functional performance of the road, namely the IRI value as a result of road preservation activities on traditional contracts is better than the IRI value on long segment contracts, which is not in accordance with the expected target. Due to the lack of understanding of the scope of routine maintenance activities, the Directorate General of Bina Marga modified its payment from lump sum to volume based in 2017. As a result in 2017 the IRI value decreased. There is a potential benefit for implementing long segment contracts, as road conditions get better maintained and the cost of road maintenance becomes more efficient because the work results are held in accordance with the applied performance indicators and program optimization can be achieved. But, there are challenges that are still to be faced, namely the contractors' lack of experience knowledge, and understanding of implementing long segment contracts.

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