SUSTAINABILITY EVALUATION OF DEWARUCI UNDERPASS INTERSECTIONS

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Abstract

Indonesian commitment to sustainable development needs to be supported by real actions. Such as to organize sustainable road construction. The Ministry of Public Works Policy related to the field of road has been in line with the international agreement of sustainable development. However, to make sure that road projects have been implemented in sustainable way, a proper assessment of the sustainability measures is required. Dewa Ruci underpass road project was one of case study of sustainable road system rating. The procedure of the rating system is done by collecting the required documents comparing with the sustainable criteria of Green Road Rating System. Road projects in Indonesia have met the technical standards and some of the environmental requirements that have been issued by the Government. Dewa Ruci underpass projects including projects that have met the technical standards and environmental requirements. From the efforts of sustainable practices that have been performed, Dewa Ruci Underpass project was rated according to the rating system, and it reached the level of four stars. The criteria on the Green Roads still have to be disseminated to be known by those stakeholders, besides the need to disseminate the rating system. Thus road projects in Indonesia can be more sustainable. Implementation of sustainable road rating system in Indonesia needs to be supported by dissemination.

Keywords: system rating, road sustainable, principle of sustainable road

Abstrak

Komitmen Indonesia untuk pengembangan berkelanjutan diperlukan dukungan dengan aksi aksi yang nyata, seperti organisasi konstruksi jalan berkelanjutan. Kebijakan Kementerian Pekerjaan Umum terkait dengan sector jalan telah selaras dengan perjanjian internasional untuk pengembangan berkelanjutan. Walaupun demikian, untuk meyakini proyek proyek dikerjakan secara berkelanjutan, penilaian yang tepat untuk pengukuran keberlanjutan dibutuhkan. Proyek *Underpass* Dewa Ruci dipilih untuk kasus studi sistem peringkatan jalan berkelanjutan. Prosedur sistem peringkatan dilakukan dengan pengumpulan dokumen dokumen dan dibandingkan dengan Kriteria Sistem Peringkatan Jalan Hijau. Proyek jalan di Indonesia harus memenuhi standar teknis dan beberapa persyaratan lingkungan yang ditetapkan pemerintah termasuk *Underpass* Dewa Ruci. Ditinjau dari upaya keberlanjutan yang dihasilkan, Underpass Dewa Ruci telah dinilai sesuai dengan sistem peringkat jalan dan mencapai peringkat bintang empat. Kriteria jalan hijau perlu didesiminasikan kepada seluruh pemangku kepentingan, khususnya sistem peringkatannya. Lebih lanjut, proyek proyek jalan di Indonesia akan dapat lebih berkelanjutan. Implementasi peringkatan jalan berkeselamatan perlu didukung dengan upaya-upaya diseminasi.

Kata-kata kunci: sistem peringkatan, jalan berkelanjutan, prinsip prinsip jalan berkelanjutan.

INTRODUCTION

The strategic plan of the Ministry of Public Works (PU) 2010-2014 states that the priority of public works infrastructure development is the achievement of sustainable development and environment conservation. The plan is explained further in priorities of

the Directorate General of Highways, as found in the Directorate General of Highways Strategic Plan 2010-2014, with a goal of creating a sustainable national road network with adequate mobility, accessibility, and safety.

Institute of Engineering Research (IRE) in agreement with Construction Development Board (Bapekon), Directorate General of Highways (DGH), and Indonesian Road Development Association (HPJI) in 2012 agree to adopt the concept of the Green Roads. The role of IRE is to prepare the rating system for the road condition in Indonesia. In 2013 IRE has prepared a guideline draft related to the implementation of the Green Roads Rating System.

The are three requirements for the Green Roads rating system. These requirements are pre-feasibility study report for new roads and reconstruction, Environmental Permit (as regulated by the Government Regulation No. 27/2012 on Environmental Permit), Environmental Impact Assessment (as regulated by the Government Regulation No. 27/1999 on Environmental Impact Assessment) or the Environmental Management Program and Environmental Monitoring Effort (as regulated by the Ministerial Regulation of Public Works No. 10/PRT/M/2008 on the Determination of Types of Business Plan and/or the Public Works Sector Activities Requiring UKL-UPL) and all of these must be completed. The requirements assessment obtained voluntarily divided into five groups of criteria or category. The five categories include: (1) Environment And Water, (2) Access and Transit (3) Implementation of Construction (4) Materials and Natural Resources, and (5) Road Pavement Technology .

Dewa Ruci underpass construction project is a project assessed by the Green Roads rating system. The design of the underpass was conducted in 2010 and the project implementation was between 2011 to 2013, before the Green Roads rating was arranged, or in other words the underpass project is not designed to be rated according to the Green Roads rating system. However the road underpass project was still possible to be evaluated for the sustainability criteria used by the Green Roads. This paper aims to evaluate the sustainable practices of Dewa Ruci underpass project. The instrument used is a rating system prepared by the IRE in 2013.

DEWA RUCI UNDERPASS PROJECT

Overview

Dewa Ruci intersection is an intersection with 5 arms with each arms carried high traffic volumes, including the road serving to and from the tourist area of Nusa Dua and the Ngurah Rai International Airport and surrounding areas. Because of rapid development in the area, traffic congestion often occurs at the intersection.

Several studies related to the performance of Dewa Ruci intersection indicate that the traffic volumes passing this intersection was already exceeded the intersection capacity. A feasibility study in year 2007 showed that the junction should be developed with a total

length of 1000 meters with approximately 450 meters as underpass structure. Another study is related to the preparation of Environmental Management Plan and Environmental Monitoring Effort (in Indonesian language is known as UKL-UPL). UKL-UPL study was performed since the length of the road to be constructed was 1000 m.

Works Phase

Implementation phase of development consists of the pre-construction and construction. Pre-construction include an inventory of the condition of the surveying road alignment, land acquisition, and relocation of existing utilities at the project site. The utility in question is the power grid, telecommunications networks, and water pipelines.

Construction phase consists of: (1) mobilization of labor, (2) the mobilization of heavy equipment, (3) the operation of the base camp, (4) transport of building materials, (5) land clearing, (6) ground work, (7) work drainage, pavement work. Summary of each job are shown in Table 1.

Post-Construction Phase consists of two activities, namely road operation and maintenance of the underpass construction. Operation is intended to optimize operational road traffic. Maintenance of the underpass construction includes routine maintenance, periodic maintenance, and rehabilitation.

Table 1 Summary of Works

Type of Works	Description
Earth Work	Includes excavation, embankment, road surface preparation and handling of disposal. Volume of about 30,000 m^3 of excavation and embankment volumes for U-turn is 2,200 m^3. Unused dugouts will be placed at locations around the project in place that requires (landscaping roads and other road projects).
Drainage	a. Drainage is done is for the benefit of the construction period and after construction. b. Relocation and normalization of left and rightside drain and add to the length of the cross drain. c. Drainage at the underpass.
Pavement	a. Type of pavement at the base began construction of the underpass is split, lean concrete, bottom slab, and AC/WC. b. Type U-turn pavement and road base course is at grade, base course, and rigid pavement.
Underpass	a. Bor pile consisting of a mounting pile bore pile without primary and secondary reinforcing steel rebars drill pile. b. Top slab. c. Dewatering is done to lower the water table. d. Drainage under the underpass. This activity is intended to accommodate the flow of water seepage and groundwater surface water runoff during rain. Pump will work automatically if the volume of water reaches a certain level. e. Work of Rigid Pavement. f. Returns road conditions and equipment such as the installation of street lighting, signs, and markings.

METHODOLOGY

The evaluation of sustainable practices at Dewa Ruci Underpass project is done by performing a sustainable rating system. Sustainable rating system used is the rating system developed by the IRE in 2013. Sustainability practices are evaluated in the form of sustainable practices in accordance with established criteria. These criteria are related to the environment and inundated, access and transit, construction, materials and natural resources, and pavement technology.

The Dewa Ruci location is a crossroads in the city with a load of sizeable traffic causing congestion. Intersection will be improved by constructing the underpass on one arm of the junction. This project has had a set of feasibility study and environmental protection and management documents.

The data used were secondary data and information obtained from interviews because the construction has been already completed when the study was performed. The secondary data were found in the Environmental Management and Environmental Monitoring Plan (UKL-UPL) document and As Build Drawing report.

GREEN ROADS RATING SYSTEM AND DATA ANALYSIS

Green Roads project requires thet a project should have: (1) Feasibility Study, and (2) the environmental document is Environmental Management Effort (UKL) and Environmental Monitoring Plan (UPL). One requirement, that was the environmental permit issued by the Ministry of Environment, was not available.

Criteria for the implementation stage according to the Green Roads construction project is shown in Table 2. The value achieved in Environment and Water Category is 17 out of 27,7 or 61%, in Providing Access and Transit Category is 8.8 out of 12.8 or 69%, in Construction Work Category is 10.8 out of 19.2 or 56%, in Pavement Technology Category is 5,9 out of 20.2, and in Usage of Materials and Natural Resources Category is 3.9 out of 20.2 or 19%. The total value obtained is 46.4 with the total value of 100.

IRE has established four levels in the Green Roads rating system. For a four-stars level, a project should have a minimum value of 45. As mentioned earlier, this underpass project was not intended to be reviewed as a green road construction. It was just reviewed after the construction. If the green road criteria planed to be implemented in the project and the information was given in the aerly stages, the value obtained using Green Roads criteria would have been different (hopefully more than 46.4).

Table 2 Achievement Criteria Values in the Green Roads

Code	Categories	Value	Total
	Category of Environment And Water		
LA-1	Service Provider has an environmental management system documentsand Inovation	1	2
LA-2	Efforts to reduce dust	0.7	2
LA-3	Efforts to protect and avoid loss of habitat	0.7	3.1
LA-4	Efforts street lighting restrictions	0.6	1.2
LA-5	Noise reduction measures	0.6	2.1
LA-6	Greening efforts	4	4
LA-7	Environmental awareness training efforts	2.7	2.7
LA-8	Provision of drainage system	5.1	5.8
LA-9	Analysis of environmental flood	1.6	4.8
	Total	**17 (61%)**	**27.7**
	Category of Providing Access and Transit		
AT-1	Access and Pedestrian Facilities	1.4	2.5
AT-2	Access and Facilities Cyclists	0	1.4
AT-3	Access and public transport facilities	1.6	2.8
AT-4	The design of geometric and support facilities	1.9	2.4
AT-5	Safety Audit	1.2	1.8
AT-6	Community participation in the planning	0.9	0.9
AT-7	Provision of facilities for interesting sights	0.8	0.8
AT-8	Ornaments and landscape road	1	1
	Total	**8.8 (69%)**	**13.6**
	Category of Construction Work		
AK-1	The service provider has a quality management system documents	1.7	1.7
AK-2	Recycling plan at work sites	2.3	2.3
AK-3	Reduction of fossil fuels outside of the construction	0	2
AK-4	Reducing emissions from the use of equipment	0	2.3
AK-5	Reducing emissions during asphalt mixture penghamparan	0	2.1
AK-6	Setting water use	2.3	2.3
AK-7	Assurance providers	1.6	1.6
AK-8	The use of renewable energy	1	2.1
AK-9	Purchasing carbon	0	1
AK-10	Intensive coordination between the design team implementing technical-construction	1.9	1.9
	Total	**10.8 (56%)**	**19.3**
	Pavement Technology Category		
TP-1	Pavement Design of long-lived	5,9	5.9
TP-2	Pavement escaped water / porous	-	3.9
TP-3	Warm asphalt mixture	-	3.1
TP-4	Pavement can reduce local temperature increase/cold	-	4.0
TP-5	Pavement to reduce noise	-	3.3
	Total	**5,9 (20 %)**	**20.2**
	Category of Materials and Natural Resources		
M-1	Reuse of old paving materials with different functions *(re-use)*	0	4.7
M-2	Balance-pile excavation	0	2.8
M-3	Material recycling (recycling) in lieu of new materials	0.6	5.7
M-4	The use of local materials	1.1	3.6
M-5	Energy efficiency street lighting	0.5	1.7
M-6	Utilization of excess material for off-site project	1.7	1.7
	Total	**3.9 (19%)**	**20.2**
	Total Value	**46.4**	

DISCUSSION

Dewa Ruci Underpass Project shows that the social, economic, and environmental aspects have been met. These aspects are not met entirely due to the type of work The underpass is located in the city center. In the design stage, the project was not intended to be evaluated and ranked according to the Green Roads System. The evaluation was performed after the project construction was completed.

Criteria for the Environment category and Water interesting in this project is the maintenance condition of the statue of Dewa (Lord) Ruci which is very important to local community, particularlu during traditional ceremony. This issue became special in this project and it needed skill and technology to maintain the sculpture. For this case, steel sheet pile erection was used as given in Figure 1 (a). Another aspects also considered was decorating the wall built in the underpasses that shows the local culture (aesthetics), as shown in Figure 1 (b).

(a) Steel Sheet Pile Erection (b) Decorating Wall

Figure 1 Steel Sheet Pile Erection and Decorating Wall

With all of the criteria availabvle, it is necessary to add social criteria including protection from noise for public, which can be done through the provision of noise barrier. For this project, this noise barrier provision is important because the position of the junction is in the city center and close to residential areas.

Interesting criteria related to the Access and Transit Category include the use of underground technology for utilities (ducting utility), such as telecommunication cables, water pipes, and electricity. If there is a need for adding wiring or plumbing repairs, the workers should be able to directly open the duct without disturbing other user access to sidewalks or roads, as shown in Figure Figure 2.

The provision of access and facilities for pedestrians, cyclists, and public transport in the the Access and Transit Category, for this project is not optimal. The possible explanation for this to happen is that the designer did not notice the criteria of Green Roads during the design stage.

Figure 2 Space for Utilities

The recycled material criteria, related to minimizing the amount of materials discharge, in the the Construction Implementation Category is interesting. This can be beneficial in executing the work. Intensive coordination between the design and the project teams should continuously exist to streamline activities, cost, and implementation time.

It was found in this project that project was still not implementing the use of water saving activities, energy, and transportation employee savings. These criteria should be informed to the designers during the design stage.

For material usage and natural resources criteria, it is interesting to use local materials and minimise the use of materials from out of the project location. The implementation of this requirement could make the project more efficient.

CONCLUSION AND SUGGESTION

Road projects in Indonesia should meet the technical standards and environmental requirements issued by the Government. Dewa Ruci underpass projects was one of the projects which have met the technical standards and environmental requirements.

Technical rating system for sustainable practices has been compiled by the Engineering Research Institute. Using the criteria developed by the Institute, the Dewa Ruci Underpass Project got a value of 46.4 or reaches the fourth level or the four stars.

The Green Roads Criteria still have to be disseminated to all road stakeholders in Indonesia When the concept is well understood, hopefully road projects in Indonesia can be more sustainable.

The implementation of the rating system should be done before the tender process of road projects. Each road project proposed a Green Roads Project should be arranged to meet the Green Roads requirements.

Implementation of sustainable road rating system in Indonesia needs to be supported. This support can be in the form of legislation and government policy, standard guidelines, experts, and institutions that can provide guidance and assess the sustainable development path.

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