Reconstruction of Road Infrastructures after Tsunami Disaster -
Getting Safer Roads? A Case Study in Aceh Province, Indonesia

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Abstract: Tsunami wave up to 12 meters occurred on 26 December 2004 flattened about 800 km stretch of Aceh’s coast and destroyed most of the existing residential, public buildings, paddy fields, fish ponds and the infrastructures within and surrounding the coastal areas. Around 3,000 km road and 120 bridges have been recognised to be rebuilt. Thousands of road projects need to be implemented within the four (4) years reconstruction period. Thus, most of the road developments have been focused on the repaving works rather than build new road alignments with better hierarchy, geometry and adequate road furniture. As the Government intends to implement the road safety audit on road project to provide safer roads, it was noted that the authority missed the opportunity to conduct the audit during the design stages.

Key Words: tsunami disaster, rebuilding safer roads, road safety audit

1. INTRODUCTION

The earthquake occurred on 26 December 2004 with its epicentre situated about 150 km off the west coast of Aceh Province in Indonesia had caused the tsunami wave up to 12 meters and flattened about 800 km stretch of Aceh’s coast. The natural disaster killed some 132,000 people with 37,000 missing and destroyed most of the existing residential, public buildings, paddy fields, fish ponds and the infrastructures within and surrounding the coastal areas.

Considering the extent of the devastation, the Government of Indonesia (GOI) declared the tsunami in Aceh as a national disaster. Following the declaration, the international responses and aids came from the entire world. More than 130 countries provided assistance to this humanitarian mission. Around 16,000 military troops from different countries were deployed for rescue missions, evacuation, logistics and medical support during the emergency period till March 2005 (cf. BRR, 2008).

At the end of emergency phase, the government assigned the National Development Planning Agency (BAPPENAS) to coordinate the establishment of a rehabilitation and reconstruction plan for Aceh and Nias. Government agencies in cooperation with local, national and international bodies participated in the process of developing the Master Plan. The government also declared the establishment of the Agency of the Rehabilitation and Reconstruction for the Region and Community of Aceh and Nias (BRR) in April 2005.
In line with the establishment of the agency (BRR), the government provided a large amount of funds to rehab and reconstruct all the destroyed infrastructure caused by tsunami. International donors including public and private contributions, donor agencies, international NGOs, multilateral cooperation agencies and the United Nations also assisted significant funds during the rebuilding process. As specified in the blue print, the estimated total funds needed for rebuilding Aceh dan Nias is up to Rp 60 Trillion (about USD 6 billion).

Table 1 shows the devastations occurred and progress of the rehabilitation and reconstruction till October 2007 according to the available data from BRR (2008). It is noted from the table that road mileage needs to be rebuild is about 3,000 km long and 120 nos of bridges.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Destroyed/Required</th>
<th>October 2005</th>
<th>October 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Housing</td>
<td>120,000 unit</td>
<td>10,119 unit</td>
<td>102,063 units</td>
</tr>
<tr>
<td>Teachers</td>
<td>2,500 teachers died</td>
<td>1,964 substitute</td>
<td>22,548 people</td>
</tr>
<tr>
<td>Schools</td>
<td>2,006 unit</td>
<td>132 unit</td>
<td>837 units</td>
</tr>
<tr>
<td>Worship Facilities</td>
<td>11,536 unit</td>
<td>141 unit</td>
<td>data is unavailable</td>
</tr>
<tr>
<td>Health Facilities</td>
<td>127</td>
<td>38</td>
<td>534 units</td>
</tr>
<tr>
<td>Fishing Boats</td>
<td>-</td>
<td>4,379 unit</td>
<td>data is unavailable</td>
</tr>
<tr>
<td>Fish Ponds</td>
<td>20,000 ha</td>
<td>19,299 ha (cleared)</td>
<td>data is unavailable</td>
</tr>
<tr>
<td>Paddy Field and Plantations</td>
<td>60,000 ha</td>
<td>30,926 ha</td>
<td>data is unavailable</td>
</tr>
<tr>
<td>Roads</td>
<td>3,000 km</td>
<td>-</td>
<td>2,006 Km</td>
</tr>
<tr>
<td>Bridges</td>
<td>120</td>
<td>-</td>
<td>216 units</td>
</tr>
<tr>
<td>SME (micro-financing)</td>
<td>100,000 ukm</td>
<td>3,640 ukm</td>
<td>99,710 units</td>
</tr>
<tr>
<td>Sea Ports</td>
<td>14 ports</td>
<td>5 (under construction)</td>
<td>17 units</td>
</tr>
<tr>
<td>Airports</td>
<td>11 airports/air strips</td>
<td>2 airports</td>
<td>10 units</td>
</tr>
</tbody>
</table>

Source: BRR Data (2008)

2. ISSUES ON REBUILDING ROAD INFRASTRUCTURES

Within the four (4) years of rebuilding period it was targeted that thousands of project packages shall be conducted to develop better living environment especially within the destroyed areas. Although the emergency response phase has already ended (three months after the tsunami), thousands of refugees were still placed in the temporary barracks spread over the tsunami affected areas. The authority may experience difficulties in prioritising which is the highest priority project that should be conducted in earliest time.

Therefore, the normal procedures in implementing the civil works including building the infrastructures based on the detail designed may need to be overlooked. Existing roads, bridges, ports and jetties were damaged and caused thousands of refugees being isolated for months. At that time, the only transportation modes that can be utilised to reach the isolated areas is helicopter and small size aeroplanes.
As the capacity of both air transport modes were relatively low and can only bring light goods, the acceleration of road infrastructures and port constructions must be conducted immediately although the detailed design of the proposed roads may not be available. The authority attempted to utilise the existing road alignments. Nevertheless, most of the roads in the coastal areas had been destroyed and some sections situated too close to the coastline. Thus, new road alignments without proper design need to be implemented for the emergency roads and these roads may not be utilised after the emergency phase.

The situation continue to occur in the first few years and this caused most of the road constructions only repaved the damaged roads rather than providing new routes with better road alignments and furniture. The improvement on the road cross section element also may not be conducted as the existing roads have relatively narrow R.O.W. While to extent the R.O.W, it requires to get the approval and pay the compensation to the land owners. The government may have adequate funds but many of the land owners killed by tsunami and the lack of regulations shall require long time to go through the bureaucracy whereas the construction of the roads should be done as soon as possible otherwise this would interrupt the constructions of houses/shelters, schools and other public facilities.

Some of the main road projects were assisted by the international donors such as the stretches of Banda Aceh - Meulaboh (USAID, ±250km), Calang - Meulaboh (JICS, ±122km), and several arterial roads within Banda Aceh town and upgrading the provincial roads on the east coast by ADB. It is noted that the construction of the main road projects above adopts high design standard and based on the proper design stages. Nevertheless, building so many roads within the relatively short time available and during the hurly burly situation, consideration to engage road safety auditor team may be overlooked.

Photographic plates as follows show the condition of provincial road situated alongside the west coast of Aceh during the reconstruction period.

Figure 1 Bailey bridge was built as temporary bridge and used by hundreds of heavy trucks per day. It has collapsed and the heavy truck sank to the river.

Figure 2 The condition of provincial road connecting Banda Aceh and Meulaboh after tsunami disaster. Road pavement decrease from 9m to 3m wide only.
3. IMPLEMENTATION OF ROAD SAFETY AUDIT ON ROAD PROJECTS IN INDONESIA

3.1 Background

Based on the information cited from the ADB-ASEAN Regional Road Safety Program and the data from other related agencies as shown in Figure 3 and Figure 4, it can be seen that the number of traffic accidents occurred in Indonesia continues to increase. The increase is in line with the population growth, vehicle ownership and the road mileage that was built.

![Graph showing the number of road accidents in Banda Aceh town](image)

*Source: Analysed based on ADB data, 2003*

Figure 3 Number of casualties caused by road accidents in Indonesia

![Graph showing the number of road accidents over the country](image)

*Source: Analysed based on Police data, 2008*

Figure 4 Number of road accidents in Banda Aceh town based on Police report
The trend, however, influences the road and transport authorities in Indonesia to take drastic actions to reduce the number of road accidents and decrease the level of fatality. For example, the Department of Transportation has issued guidelines called Roadmap to the National Transportation Safety Improvement. The roadmap specifies that the increase of transportation safety covers air, sea, railroad and also the road transportation.

In terms of increasing road transport safety, the roadmap recognises some major items as follows that need to be improved:

- Regulation;
- Law Enforcement;
- Facility;
- Human Resources;
- Institutional;
- Operators; and
- Society.

In fulfilling the action plan to increase safety on traffic and road transport (LLAJ), the roadmap targeted that the implementation of the Road Safety Audit will begin in year 2008. In the meantime, the Department of Public Works has issued a Technical Guideline No. Pd T-17-2005-B as guidance for the implementation of Road Safety Audit.

As specified in the guidelines the road safety audit guideline is to set rules and procedures of the road safety audit starting from the preliminary design stage to the operational stage. Matters stipulated in the guidelines, including the general requirements, administrative, and technical implementation of the audit. In addition, the guidelines details stages of the audit including providing the audit check lists.

### 3.2 Roadmap to Improve Road Transport Safety

The main objective of the roadmap is to improve road transport safety which involves:

- The implementation of traffic safety products such as road signs, road markings, guardrail, and delineator throughout the country;
- Providing equipments for the institute of accident research (UPK);
- Developing information systems management for road transport safety;
- Identify and improve the accident prone areas (DRK); and
- Road Safety Audit.

### 3.3 Road Safety Audit According to the Guidelines No. Pd T-17-2005-B

Some of the important items as specified in the technical guidelines are translated into English and presented as follows to provide further information on the road safety technical guidelines published by Department of Public Works.
3.3.1 Definition of Road Safety Audit

Road safety audit is part of the strategy to prevent traffic accident occurrences by improving road geometry and road furniture that may lead to potential conflict of traffic and accidents through a comprehensive, systematic, and independent assessment.

3.3.2 Purpose of Road Safety Audit

The main objectives of road safety audit are:

- to identify potential safety problems for road users and other aspects that may influence the safety features of road projects; and
- to ensure that all the design of new roads shall provide safe operation.

3.3.3 Principles of Audit

The principles as follows must be met in the implementation of road safety audits:

- the scope of the audit and the auditor team must be clearly stated in the audit project proposal;
- the auditor team should not be involved in the design of the project;
- the auditor team should have knowledge and experience in the field of road safety;
- audit findings must be documented and reported in every phase of the audit;
- implementation of audit procedures should be transparent and systematic;
- implementation of the audit in accordance to the geometry standard and the principles of road safety as specified in the NSPM.

3.3.4 Stages of Road Safety Audit

The audit shall be conducted in four phases, namely:

- audit on the pre design stage;
- audit on the draft engineering design stage;
- audit on the detailed engineering design stage; and
- audit on the road operational stage.

3.3.5 Audit Scope of Works

The scope of work of an audit involves:

- development of new road;
- upgrading the mid block section;
- upgrading an intersection;
- upgrading pedestrian footpath and bicycle lane;
- upgrading the access road to residential, office blocks, industry zone, etc.
Based on the aforementioned, it can be summarised that Government of Indonesia already provided regulations and technical guidelines in order to implement the road safety audit on road infrastructures beginning from the design stage till the operation of the road. Thus, with the available regulations and references it is expected that the implementation of road safety audit can be done for all road projects within tsunami areas in Aceh Province.

4. IMPLEMENTATION OF ROAD SAFETY AUDIT FOR ROAD PROJECTS IN TSUNAMI AFFECTED AREAS

Although the regulations and references for implementing the road safety audit are made available to the authority, however, during the emergency situation as occurred in tsunami affected areas, the implementation of normal process of road design only without the road safety audit was difficult to be conducted. Therefore, it was noted that during the design stage the implementation of audit may not be conducted. Road safety audit on the existing roads, however, had been carried out for several road sections in year 2008 to fulfil the roadmap.

It needs to be highlighted that currently there are two government agencies involved in road transport development and traffic control at province level, namely, Dinas Bina Marga (Provincial Office of Public Works Roads) and Dinas Perhubungan, Komunikasi, Informasi dan Telematika (Provincial Office of Transportation, Communication, Information & Telematics). In general, Dinas Bina Marga deals with the design and construction of road projects while Dinas Perhubungan, Komunikasi, Informasi dan Telematika deals with road furniture and traffic system and control.

Therefore, both government agencies shall be responsible for implementing the road safety audit. Considering the stages of road safety audit, Dinas Bina Marga may be responsible to carry out the Stage 1, 2 and 3 of the audit, while Dinas Perhubungan, Komunikasi, Informasi dan Telematika may have responsibility for Stage 1 and Stage 4 of the audit.

As mentioned earlier, due to the emergency situation the rebuilding of the damaged roads had been carried out mostly by repaving the old roads without improving the road alignment and the cross section. For low road category it is tolerable since the road adopts lower design speed. Nevertheless, for high standard road category it is the right time to improve the road geometry as well as the design criterion adopted. It is also available to improve the road networks hierarchy during the rebuilding period to obtain smooth and safer road operation in near future.

Unfortunately, all the parties missed the opportunity to improve the road safety features during the design stages for most of the road projects due to the emergency situation that provides very short time to rebuild the road infrastructures within tsunami affected areas. For the main roads assisted by international donors, it is noted that the improvement focused more on the road geometry. The responsibility for providing proper road furniture, traffic control and road hierarchy shall be given to the State Government.

Thus, the improvement on the safety features of roads within tsunami affected areas shall be carried out as if tsunami disaster never happen. These due to most of the road rebuilt as the status quo without significant improvements especially on the issues related to the road safety features.
5. ROAD SAFETY FEATURES OF EXISTING ARTERIAL ROAD

As there was no significant improvement on road safety features of road development during the rebuilding period, the authority may need to conduct the road safety audit at least on the operational stage. Based on the experience, road safety features need to be improved on the roads within the tsunami affected areas particularly for the high road category as road safety audit is new phenomenon within the country and was never conducted earlier.

For example to assess the road conditions within tsunami affected areas, an audit on the existing arterial roads within Banda Aceh town (the capital of Aceh Province) has been conducted. The road sections are situated in suburb area of the west part to the south part of Banda Aceh town and namely Jalan Soekarno Hatta.

Comments on major items of the above mentioned road sections including the site photos are shown as follows.

Figure 5 Motorists’ visibility is obstructed by the foliages on road bend.

Figure 6 Paved shoulder width is not consistent and narrow on the bridge section.

Figure 7 Lane width of u-turn provision is 2.0m wide only. The possibility of rear-end collision is high when vehicle turning.

Figure 8 Inadequate number of signal indication may cause the front vehicle not able to see the traffic signal.
6. CONCLUDING REMARKS

Based on the available information and the site observations on the road projects during the rebuilding process after the tsunami disaster in Aceh Province, Indonesia it can be summarised that due to the emergency situation the implementation of road safety audit may not be conducted for most of the rebuilt roads particularly the audit on the design stage.

Although the regulations (roadmap) and technical guidelines have been established since year 2004/2005, the province may lack the readiness and road safety auditors that meet the requirements to implement the road safety audit for road developments in tsunami affected areas.

Moreover, this may also be due to thousands of road project packages that were implemented during the four (4) years reconstructions period, thus, the available engineers focused more on the design process and supervision of road projects rather than to be the independent road safety auditor.
The audit on existing road (operational stage) has been conducted for some road stretches and this is an advance action by the authority in the process of road safety implementation.

Finally, most of the roads rebuilt through repaving the old road alignment with slight changes on the road geometry and cross section. While the existing roads never been audited, thus, the authority need to conduct the road safety audit especially for high road category within the tsunami affected areas because the rebuilt roads may not be safe for road users particularly for the vulnerable road users (pedestrian, bicyclist and motorcyclist).

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