International Balkans Conference on Challenges of Civil Engineering, BCCCE,
19-21 May 2011, EPOKA University, Tirana, ALBANIA.

Condition Assessment of Existing Reinforced Concrete Bridges in Albania

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ABSTRACT

Conditions of existing bridges are often problematic issue for many countries. The combination of a variety of local factors that cause deterioration raises the needs for local survey for bridges. Concrete bridges in Albania had been constructed with different standards in different periods and exposed traffic loads which have rapidly increased last two decades. Despite the fact that existing condition of these bridges has not been clearly defined yet. Therefore an attempt was made on this study to draw a general picture of Albanian's reinforced bridges. The condition of Albanian bridges was presented in this paper based on visual inspection of 24 bridges (3.6 km of total bridges length) from different part of the country, concentrating on local causes of deteriorations. The main causes of the defects are figured out in the study as traffic load, nature force, aging, lack of maintenance and last but not least construction and design deficiencies. Study concludes that general physical state of the bridges are poor, therefore, the service provided by the bridges are in potential hazards.

INTRODUCTION

The Bridges are the most delicate and critical points for road network. The tragic collapse of the Silver Bridge in US on December 15, 1957, resulted in the deaths of 46 people. This tragic collapse led to the development of bridge inspection standards in USA. Today advance bridge management programs are widely used to ensure the service provided by the bridges does not disturb throughout specified service life (1). The management systems are specified different types of inspection to identify distress and its causes in periodic time frame. BS 5400(2) British Standard for design and construction of steel, concrete and composite bridges emphasizes that bridges will require regular inspection under competent direction. The main purpose of the inspections is keeping bridges healthy, safe, and functional. The inspections are needed to ensure bridges serve efficiently and maintenance costs are maintained in estimated budget during its specified life. Otherwise many reinforced bridges have to be demolished on their mid ages or repaired with its first construction budget or much more than its estimated maintenance budget. Disturbance of the service provided by bridges may be doubled the cost. In addition catastrophe may be caused by unsafe bridges could not be recovered.

There are many bridge management programs used by different country (3-9) and "Bridge Management Expert" (BMX) version 4.0 is used as first bridge management system in Albania at 2010(10). This program includes inventory system, inspection system, data management to record inspections' findings and maintenance recommendation. Conditional inspections of 562 bridges were performed by three trained engineers in one year as a

European Union funding project. Although it was the first inventory and inspection work in country, final report did not provide details on level and condition of deteriorations.

The deteriorations on the reinforced bridges are classified and rated depending on the location, size, time to appear and environmental conditions. Based on classification and rating, the problem have potential to lower the durability, load-carrying capacity and service life therefore the quality of service provided by the structure. Thus, assessment of bridges needs serious attention, especially for strategically located one. Causes and effects of distress on bridge structures are explained in depth in many bridge inspection and maintenance guides (3-6).

Successful, long-term repair and strengthening of deteriorations on reinforced concrete bridges depends on investigating and evaluating the deterioration levels. Therefore, most of the inspection guides pay special attention on effective rating system. There are many factors having role on a deterioration level including temperature changes, loading, construction methods and many more. Exact key factors that lead to some type of deteriorations such as cracks and expansion joint failure is very difficult to identify. Furthermore, the roles of the associated distresses on worsening the problem of reinforced concrete have been a major concern for the bridge inspector. With this complexity, bridge inspection is cumbersome procedure without trained person and most importantly computer help.

This study were indented to identify and rank the common distresses on reinforces concrete bridges in Albanian. Visual inspection of reinforced concrete bridges were carried out to identify common defects.

Inspecting the large number of bridges which are spread throughout the country is difficult, expensive task and required skilled personnel. Therefore certain types of bridges were chosen out of all available data. Representativeness of the selective bridges was the first obstacle to overcome. Selection was carried out based on previous report and initial inspection on existing condition of Albanian Bridges. The study categories the types of problems base on the types of bridges to draw clearer pictures of condition of the bridges. The study concluded general condition of existing bridges in Albania to be proactive and reactive in helping these structures remain in service in the most cost effective manner.

Some local and general defects were already identified based on the categories in this research, consist of spalling of concrete cover, rusting of reinforcement, deterioration, failure of bearings, chemical attract and scouring.

METHODS

The research is based on visual inspection, literature reviews. Interview with persons, who had been part of the design and construction of the structure, were taken an important part of data collection. The main purpose of the study is to assess the current statues of the RC bridges in Albania and figure out common deficiencies. Comprehensive inspection criteria were prepared from literature to carry out the visual inspection. The inspection was carried out more than 24 bridges from different part of the Albania. Representativeness was the major objective during the selection of the sample bridges. Author tried to select bridges based on construction period, importance and locations. Decision of the selection was carried out together with persons who were involved in design and construction. Final selection was done among 562 reported bridges in Albania.

Obtained data from the visual inspection were presents in terms of defects severity and frequency. A rating system was employed from 1 to 5 to categorize the severity. The severities of defects are classified as follows;

Very High Risk (Rating 5): Being heavily and critically damaged and there is high risk for the safety. It is necessary to implement urgent repair or strengthening work. A detailed inspection should be carried out.

High Risk (Rating 4): Damage detected is critical and thus it is necessary to implement repair work. A detailed inspection should be carried out. Replacement work may be needed.

Medium Risk (Rating 3): Damage detected is slightly critical and it is necessary to carry out routine maintenance work.

Low Risk (Rating 2): Damage detected and potential risk exists but low. It is necessary to record the condition for observation purposes.

No Risk (Rating 1): Damage detected and it is necessary to record the condition for observation purposes.

Frequency of the defects is very important to draw overall pictures of the general conditions. Frequencies of the problems are classified as;

Very Frequent (VF): if more than 65 % of total number of the bridges has same problem

Frequent(F): if 40 to 65 % of total number of the bridges has same problem

Sometimes(S): if 20 to 40 % of total number of the bridges has same problem

Rare(R): if less than 20 % of total number of the bridges has same problem

RESULT

Many existing bridges in Albania are in poor condition, mainly because of lack of maintenance, nature force, construction and design deficiency, aging and traffic load. Therefore functionality, physical capacity and safety of the bridges are big concern. The visual inspection results of 24 for bridges are summarized at Table 1. As shown in table most of the visual and accessible members have small or big problems due to different reasons. Several outstanding deficiencies are needed to be highlighted in order to draw general picture of the existing condition of the structures.

Bearings are the border between substructure and superstructure. It is many responsible to transmit loads from the superstructure to the substructure, allows rotation caused by deflection and depending on the types, it permits horizontal movement of the beams due to thermal expansion and contraction. Failure or malfunction of this element will lead extra stress on the superstructure. This can grow progressively and cause serious problems.

Frequency of the bearing problem is very frequent. Almost all bridges' bearings have problem rating from 3 to 5. Many of them are needed to be change and some of them could be recover by cleaning and repair. It is very usual to see serious bearing problems such as; rusted bearings, frozen bearings (Fig 1(a)), Excessive Bulging of Neoprene Bearings.

Another border element is expansion joints. The main functions of expansion joints are absorb movement caused by high traffic volumes, temperature stress of expansion and contraction. They are active members and replaced several times during service life of the bridge. Moreover they are directly affects traffics and safety above the bridges. Therefore close attention needs to be paid for this member. The main defects on this member are abnormal spacing, different in level, abnormal noise, water leak and pavement crack.

Expansion joints' problems are other very frequent problem observed during visual inspection and almost all type of the defects can be found on Albania' bridges. Moreover many bad construction and repaid practice worsen the expansion joint associate problems. A defects expansion joint can be seen at Fig. 1(b).Common expansion joints problems in

Albanian's bridges are abnormal noise, different in level water leak and pavement crack. Most of them need to be change by an expert contractor and some could be recovered by repairing.

Table 1 Bridge Member and Problem Rating

No	Bridge Name	Age	Material	Span Number	T. Length (m)	Member Rating					Problems Rating				
						Expansion joint	Bearing	Wearing	Drainage	Parapets	Scouring	Poor const.	Chemical Attack	Water leakage	Cracks
	Frequency of the defects					VF	VF	VF	VF	VF	VF	VF	VF	VF	VF
1	MbiklaimiH. Vore	22	RC	18	320	5	5	5	5	5	N/A	5	5	5	5
2	Mbiklaimi H.Sukth	10	RC Steel	1	20	5	4	4	5	2	N/A	2	2	2	4
3	Mbiklaimi Maminasit	10	RC (box)	1	8.2	N/A	N/A	2	N/A	2	N/A	2	2	2	2
4	Ura e Babanit	~45	RC	5	60	4	5	2	5	4	3	5	5	4	3
5	Ura eKucit	~40	RC	5	60	3	4	5	5	3	3	5	4	3	5
6	Ura e Popcishtit	~40	RC	1	~18	5	5	5	5	5	5	3	2	5	5
7	Ura e Kamzes	~ 35	RC	7	140	5	5	2	3	3	2	3	2	3	3
8	Ura eTapizes	~ 30	RC	7	210	5	5	3	5	3	5	5	5	4	5
9	Ura e Paskuqanit	~ 30	RC	5	150	5	5	2	5	2	5	5	3	3	3
10	Ura e Zall-Dajtit	~30	RC	8	240	5	3	3	5	4	3	3	3	4	2
11	Ura eBeshirit	~50	Con Arch	3	124	N/A	N/A	3	5	3	2	3	3	3	3
12	Ura e Kasines	~ 45	Con Arch	3	104	N/A	N/A	5	5	3	2	3	4	4	3
13	Mbikalimi I Dajlanit	10	RC Steel	10	300	4	4	2	2	2	2	2	2	2	2
14	Mbikalimi I Plepave	12	RC	13	470	2	3	2	2	2	2	2	2	2	2
15	Mbikalimi I Sukthit	10	RC	1	~20	2	3	2	2	2	2	2	2	2	2
16	UraVrusha Mjekez	~50	RC	3	33	3	3	3	5	4	2	3	4	5	3
17	Ura e Zaranikes	~40	RC	3	27	3	3	2	4	4	2	3	3	4	3
18	Ura e M. Treganit	26	RC	3	51	5	4	5	3	3	2	3	4	5	2
19	Ura eLinzes	-	Con Arch	1	7	N/A	N/A	3	N/A	5	2	3	2	2	2
20	Ura e Farkes	~35	RC	3	40	2	3	2	3	2	2	2	2	2	3
21	Ura e Peshkatarit	11	RC	5	125	5	3	3	3	3	2	2	3	3	5
22	Ura e Zaranikes	~15	RC	6	102	3	3	3	4	3	2	3	3	3	3
23	Ura e Kirit	-	RC	8	150	5	3	3	3	4	4	3	3	2	2
24	Ura e matit	33	RC	33	787	5	4	2	4	5	5	3	3	4	2

Other elements' problems of the substructure and superstructure of the bridges are also very frequent problem as shown in Table 1. Drainage and parapets does not exist for some of the bridges and more than half of the inspected drainage systems are not functioning Fig1. (c).

Deck health and parapets condition are directly related with traffic safety. Failing of these two members may end up with tragedy. Unfortunately some accident ended up with life

lost in Albania bridge. The casualties might be prevented or lessen, if a sound parapet structure were exist on the bridge. It is believed that many of fatal accident could be prevented or at least casualties were lessened with proper deck and parapet system.

(a)Corroded & Frozen Bearing b)Defected Expansion Joint (c) Failed drainage system

Figure 1 Defects on bridge members

Defects on different members result with partially lost of member for short term and potential failure of bridge for long term. Although bridge can function with this defects and the structure seems sound for bridge user, risk of structural failure is high, if remedies are not carried out in time. Literature shows that similar types of defect ended up with structural failure and casualty.

(a)Water leakage and chemical attack (b)Poor workmanship and bad construction practice (b) Heavy Scouring and chemical attack on piles' concrete

Figure 2 Bad construction practice and chemical attack on bridge member

Water leakage is source or trigger of most of the durability problems in a bridge structure. All the drainage and sealing systems have potential to be blocked or leaked if necessary maintenance does not carry out. A simple shrinkage cracks could lead structurally dangerous problem if it associates with water leakage. Water leakage drags all chemicals from the sealed part of bridge to naked substructure and superstructure surface. Chemicals such as deice salts and chemical drop from trucks and vehicles may cause serious durability problems as shown in Fig. 2 (a).

Bad construction and poor workmanship is found mostly on mid ages bridges. Very thin or no concrete cover is first visibly deficiency. It is believed that this thin cover spall after few year and left reinforcement without protection. This result with heavy corroded reinforcement and severe slapping as shown in Fig. 2 (b)

Scoring is very common and one of the most difficult part of bridge inspection. Many factors are having role on scour on bridge foundation such as: river base, scour protection type, river type, flood and types of foundation etc. Scour is the major cause of bridge failure

worldwide. Therefore special attention needs to be paid for scour problem in Albania. Excessive scours were reported in some of the bridges. As shown in fig. 2 (b) load carrying capacity of piles is reduced and some of the piles lost connection with pile caps.

CONCLUSION

Inspection works were initiated in this study to identify common problems and their level. Almost all bridges in Albania were studied from previous inspection reports and 24 bridges were inspected out of 562 reported bridges. The main assist of the visual inspection works is to anticipate potential problems in existing bridges and provide guide line for detail inspections. The main causes of the defects are figured out in the study as traffic load, nature force, aging, lack of maintenance and last but not least construction and design deficiencies. It is suggested that immediate action needs to be taken to carry out urgent maintenance works and establish a maintenance team. Further detail inspection and research should be carried out to draw a maintenance plan for the bridges.

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