Introduction of road technical audit in Armenia as a criterion of quality improvement

Ye V Vardanyan *, V M Harutyunyan, A V Harutyunyan
National University of Architecture and Construction of Armenia, 105, Teryan Street, Yerevan 0009, Republic of Armenia

E-mail: yeghiazar.vardanyan@gmail.com

Abstract. Methods of implementation of technical audit are introduced for the purpose of improving quality of construction and rehabilitation works of the RA lifeline roads within the framework of the World Bank’s International Bank for Reconstruction and Development (IBRD) loans and International Development Association’s loans and grants. The rendered services and deliverables submitted to the client have been analyzed. Suggestions are provided that could be expedient to be considered by the client during the organization of design, construction and technical audit tenders.

Introduction
The technical audit of roads is a supervisory and precautionary process aimed at making roads safer and more practical due to the quality of road construction works. The following five stages of audit are internationally recognized [2]:
1. Audit of planning stage—end of planning stage of a new road project;
2. Audit of preliminary design stage—when preliminary design has been completed;
3. Audit of final design—when detailed design has been completed but the project has not been submitted for tender yet;
4. Audit of road construction work stage—conducted for the purpose of ensuring quality of works at the construction site;
5. Pre-opening audit—conducted before commissioning the new (rehabilitated) road.

The purpose of the technical audit of road rehabilitation works is to provide a professional opinion on the efficiency of the works, their timely completion and compliance to quality requirements, the requirements of the specifications and standards set in the tender documents.

Analysis
Technical audit has been conducted since 2016 for the purpose of improving the quality of construction and rehabilitation works of the RA lifeline roads within the framework of the World Bank’s International Bank for Reconstruction and Development (IBRD) loans and International Development Association’s loans and grants. It will allow the independent audit team to form an opinion on the construction works conducted on that road network.
The 1st project for roads improvement included 8 (total length of 62 km), and the 2nd project included 10 (64 km) local roads.

The actual services rendered during the technical audit include but may not be limited to the following:

- **General management audit**, which includes distribution of tasks among different actors involved in project implementation, and assessment of their management capacities, contract administration, document registration and management procedures. [1]

- **Audit of works**, which includes checking compliance of works and their values with the ones specified in the contract, the proper maintenance of records between the client, contractor and technical supervisor, consideration of environmental issues when conducting the works.

- **Audit of supervision works**, during which the process of supervision works implemented by the client and technical supervisor is verified in accordance with contract conditions, proper administration of invoices, powers of attorney, variation orders and other documents is checked.

- **Quality audit of road works**, during which the quality of construction works is observed, the compliance of works with technical specifications and standards mentioned in the tender documents is checked, the process of construction works and efficiency of implemented works, technical condition of the road, technical and operational characteristics, road quality, operational coefficient of ensuring estimated speed, condition of artificial structures, road traffic conditions (traffic safety, comfort, intensity and other parameters) are examined.

Road physical parameters are checked, detailed digital photos with GPS coordinates are provided (ph.1). Cores are taken from the pavement in order to determine physical-mechanical characteristics and gradation of asphalt concrete. By means of relevant devices and equipment various kinds of laboratory tests are carried out, including carriageway and shoulder durability and state, pavement evenness, slope inclination, state of drainage system, friction coefficient, determination of the pavement actual elasticity modulus, testing of unbound subbase materials of subgrade and so on [2].

The Auditor submits description of all the facilities that have undergone audit to the client in a simplified form and in figures that include all the parameters of road rehabilitation and reconstruction.

---

**Figure 1.** View of the road before rehabilitation

**Figure 2.** km0+162 bridge. No slab replacement envisaged in the Design.
Proposals

The Technical audit methodology is based on visual, photo and geodetic investigations, measurement data, laboratory and field tests, drawing and document study. Within the framework of the Lifeline Road Network Improvement Project (18 roads in total) efficient information exchange between the responsible parties has been examined for the purpose of the contract implementation. In order to avoid inaccuracies in collecting field data (design shortcomings and regularly modified orders in the construction process) the client has been proposed to take into account the undermentioned points in design, construction and technical audit tenders [3]:

- Transport operation characteristics of the given road;
- Current state of the road pavement and conditions;
- Measures to be taken to eliminate dangerous road sections;
- Design works shall be conducted as comprehensive road construction works - from detailed investigation of the site up to final design in order to avoid modified orders to the extent possible;
- Contractors shall be experienced experts of the field knowing well the principles of work implementation and efficient management and equipped with respective state-of-the-art technical means;
- Investigation and measurement works in mountainous areas shall be carried out before winter time while the latter shall be used as a design period in order to conduct complete data recording;
- Construction works shall be carried out in hot seasons since works conducted in cold weather conditions result in extra costs; besides cold and wet conditions are impermissible for some works (e.g. laying asphalt-concrete layer);
- Technical supervision shall be conducted by a professional organization having experienced experts and equipped with technical means;
- Prior to commencing works on the site design details shall be checked, including accuracy of sizes and comparison of other data on technological map;
- Extra testing may be demanded in the measurement process, if required;
- Daily reports and applications of contractors for each site shall be checked;
- Environmental Management Measures in contractors’ work shall be observed during the construction process, and Environmental Impact Assessment of construction works shall be conducted.

When conducting Environmental Impact Assessment, the following points shall be considered:
Changes of landscape, animal transportation networks, watercourse and groundwater level, erosion emergence, changes in land-use conditions as well as other deviations in the environmental system during construction of roads and their structures;

Possible environmental impacts predicted for environmental, economic and social components such as population, traffic participants, earth, vegetation, air, landscape, animals, monuments, reserves, acoustic comfort;

Compliance of drainage implementation from carriageway of residential areas with sanitation norms.

**Summary**

Introduction of technical audit to the Republic of Armenia aims at assuring high road quality during their rehabilitation and construction as well as road safety enhancement. Main methods of implementing road technical audit have been provided. Within the scope of the audit, task assignment to all the stakeholders engaged in the project has been examined and their management skills have been assessed. The aim of the following article is to offer practical assistance to those engaged in the activities. The audit shall also be applied for the RA interstate and republican roads.

**References**

[1] Report “Independent Technical Audit of Works Implemented for the Roads Rehabitation of LRNIP AF” TA-LRNIP-AF-Y1-Y2-2017/18, Yerevan, 2017, pp. 275.

[2] Report “Independent Technical Audit of Works Implemented for the Roads Rehabitation of LRNIP AF” TA-LRNIP-AF-Y1-Y2-2017/18 Additional financing, Year 2, Yerevan, 2018, pp. 108

[3] Bidding documents- technical specifications, Yerevan, 2016, pp. 901

[4] RACN IV-11.05.02.-99 Avtomobil Roads, Yerevan, 2000, pp. 62

**Acknowledgements**

This work has been carried out in the frame of “Creating the ways for sustainable urban, architectural and construction complexes development in RA and elaboration of directions with use of permanent monitoring systems” programme, financed by Committee of Science of Republic of Armenia.