

PUBLIC WORKS DEPARTMENT

Government of Uttar Pradesh, India

UTTAR PRADESH STATE ROADS PROJECT Under IBRD Loan No. 4684-IN

Technical Assistance for Implementation of Institutional Reforms in the Road Sector of Uttar Pradesh

REPORT TO IMPLEMENT NEW WORKS SUPERVISION PROCESSES, GUIDELINES AND PRACTICES (FINAL)

Report No. 32

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LEA International Ltd., Canada

in joint venture with

LEA Associates South Asia Pvt. Ltd., India

in association with

Ministry of Transportation of Ontario, Canada

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Glossary

ADB	Asian Development Bank	MoRTH	Ministry of Road Transport and Highways
ADT	Average Daily Traffic	MoEF	Ministry of Environment and Forest
AE	Assistant Engineer	M&E	Monitoring and Evaluation
BMS	Bridge Management System	MIS	Management Information System
BOOT	Build Own Operate Transfer	NITHE	National Institute for Training of Highway Engineers
BOT	Build Operate Transfer	NH	National Highway
BSSL	Below Single Standard Lane	NHAI	National Highways Authority of India
CBR	California Bearing Ratio	ODR	Other District Road
CE	Chief Engineer	OD	Origin and Destination
CEO	Chief Executive Officer	O&M	Operation and Maintenance
CRF	Central Road Fund	PCI	Pavement Condition Index
CRRRI	Central Road Research Institute	PCU	Passenger Car Unit
CSR	Civil Service Reforms	PMS	Pavement Management System
DAO	Divisional Account Officer	PMGSY	Pradhan Mantri Gram Sadak Yojana
DBC	Dense Bituminous Concrete	PPP	Public Private Partnership
DEE	Deputy Executive Director	PSP	Private Sector Participation
DPR	Detailed Project Report	PVA	Polyvinyl Alcohol
DRDA	District Rural Development Agency	PWD	Public Works Department
EC	Executive Committee	RMMS	Road Maintenance Management System
EE	Executive Engineer	ROMDAS	Roughness Measurement and Data Acquisition System
E-in-C	Engineer in Chief	SDBC	Semi Dense Bituminous Concrete
HDM4	Highway Development and Management System	SDL	Standard Double Lane
GIS	Geographic Information System	SE	Superintending Engineer
GPS	Global Positioning System	SH	State Highway
GO	Government Order	SHA	State Highway Authority
GOI	Government of India	SML	Standard Multi Lane
GoUP	Government of Uttar Pradesh	SPV	Special Purpose Vehicle
HQ	Head Quarter	SRF	State Road Fund
HRD	Human Resource Development	SRP-II	State Road Project-II
IBRD	International Bank for Reconstruction and Development	SSL	Standard Single Lane
IDS	Institutional Development Strategy	MIS	Management Information System
IDSP	Institutional Development And Strengthening Plan	TA	Technical Assistance
IRC	Indian Road Congress	ToR	Terms of Reference
IT	Information Technology	UP	Uttar Pradesh
ISAP	Institutional Strengthening Action Plan	UPSBC	Uttar Pradesh State Bridge Corporation
IS	Indian Standards	UPSHA	Uttar Pradesh State Highway Authority
IRI	International Roughness Index	UNDP	United Nations Development Programme
JE	Junior Engineer	VOC	Vehicle Operating Cost
MDR	Major District Roads	VR	Village Roads
MLA	Member of Legislative Assembly	WB	World Bank
MoSRTTH	Ministry of Shipping, Road Transport & Highways	WBM	Water Bound Macadam

1. BACKGROUND

The IDS Consultant (TCE) made the following recommendations regarding strengthening PWD role and capability in the supervision of works:

Construction Operation and Supervision:

Strengthen the Construction process by introducing new technologies, systematic construction supervision and independent Quality Audits and Controls.

Based on these recommendations the GoUP included 'strengthening PWD role and capability in the supervision of works' as one of the objectives of the Technical Assistance under implementation of institutional reforms in the road sector of Uttar Pradesh. In this the GoUP targeted the following action milestones under the TA Consultancy Services:

1. Implement new works supervision processes, guidelines and practices
2. Determine policy for mainstream use of independent quality audit.

Report No. 32 is presented against this background and action milestone number 1 i.e. implement new works supervision processes, guidelines and practices for core network of roads for construction and maintenance operation. The word 'Construction' in this context includes both maintenance and construction operation.

2. ACTION PLAN AND PURPOSE

In order to implement the works supervision processes, guidelines, and practices the following methodology has been adopted;

1. Overview of current guidelines and practices for construction supervision of works in UP PWD.
2. Identify weaknesses in the existing system
3. Suggest measures to improve the supervision processes and guidelines

The purpose of this report is to suggest needful guidelines for developing a model construction supervision manual applicable for construction of a typical road project.

A Construction Supervision manual is a project specific document. For an individual project a construction supervision manual compatible to project requirements is to be developed. However, a model construction supervision manual could provide a base for developing a project specific manual.

3. OVERVIEW OF CURRENT PRACTICES AND GUIDELINES IN UP PWD

In the UP PWD a Construction Supervision manual does not exist in any form. However, some circulars/Government Orders were issued by the PWD HQ which provide some guidelines/directions on construction supervision aspects of works. All these circulars/Government Orders are compiled in the book 'PWD UP Road Related circulars (1959 to 1984)' published by the Engineer-in-Chief PWD Lucknow.

The guidelines/directions contained in Circulars/Government Orders generally relate to administration, specification and planning aspects of roads.

Rules and regulations regarding financial aspects of works have been elaborated in UP PWD Manual of Orders Volume Nos. 1 and 2. Some of the forms, which are often used by the Supervisory Engineers, have been standardized.

Performa and forms which are essentially to be used in respect of technical matters during construction supervision process have not been standardized.

Supervisory Engineers in UP PWD generally discharge the responsibilities of construction supervision of works based on their subjective judgement, experience, and in accordance with the directions issued by the superior authorities. Construction supervision of works is mainly based on the stipulations contained in the Contract Documents: Conditions of Contract, Specifications, Bill of Quantities, and Drawings. The methodology for executing any items of works is seldom developed either by the Contractor or the PWD. The works are executed by the Contractors in the traditional manner without any documented methodology or planning.

The quality of works is often adversely affected by the absence of a well defined methodology for executing the work items.

On projects funded by the World Bank the Construction Supervision Consultants have developed a construction supervision manual to be used on World Bank financed project.

For implementation of PMGSY works an Operational Manual has been published by Government of India. This operational manual covers some aspects of monitoring and construction supervision of works.

4. WEAKNESSES IN THE EXISTING SYSTEM

4.1 GUIDELINES ON CONSTRUCTION SUPERVISION OF WORK

Each construction project is “custom built” due to many variables caused by weather, topography, local conditions, and design considerations. It is important to provide the necessary decisions in the shortest possible time on the several problems which are likely to occur during the construction phase. A delay in giving a decision might cause unnecessary cost overruns to the PWD as well as to the contractor. To achieve maximum efficiency in producing a quality project the proper supervision of works executed by the contractor is vital. Under the PWD system no other individual position is so important for the proper functioning of the PWD as the position of Divisional Engineer (Executive Engineer) in charge of the execution of works. An EE is charged with a heavy responsibility, since he represents the PWD in dealing with the Contractor, coordinating with Governmental agencies, the travelling public, and the tax payer. Unfortunately for discharging such important responsibilities no guidelines or manual pertaining to technical matters concerning to works is available within the PWD for guiding officers in dealing with the construction supervision of works.

4.2 PAYMENTS TO THE CONTRACTOR

The construction industry is a fast-moving and fast-changing business. Large amounts of capital are necessary for undertaking construction operations and it is therefore important that the Contractor be reimbursed for work completed in accordance with the Specifications without undue delay. The invoice for works executed by the Contractor is generally prepared by the JE on the basis of measurements recorded by him in the measurement books

In addition, accounting procedures are continually reviewed and modernized to the maximum extent possible to provide swift payment of invoices, so necessary for an economical operation. It is therefore important for the EE to ensure that all monies due to the Contractor are paid to the fullest extent possible within the payment period stipulated in the Contract.

The prevailing system of invoicing and discharging payments is cumbersome and time consuming. This system needs simplification and standardization.

4.3 METHODOLOGY OF CONSTRUCTION

In order to successfully implement a highway project the Contractor and the Supervisory Engineer must be conversant with the detailed construction methodology, including the plant and mechanical equipment it is proposed to use, the scheduling of all the various activities, safety aspects, traffic patterns and the possible interruptions to same.

Although the 'Specifications for Road and Bridge Works' (MoSRTTH) 2001, Clause 115 specifically covers methodology and sequence of work this is not currently being applied in UP PWD on normal works.

Time and cost overruns, coupled with the poor quality of the completed project, are some of the maladies often observed on projects executed without having a sound, and approved, construction methodology or programme in place.

4.4 TRAINING OF SUPERVISORY ENGINEERS

Currently there is no system in place for providing training to the PWD Engineers in the field of construction supervision of works. It is of the utmost importance to conduct training programmes or refresher courses which update the knowledge of the PWD staff engaged in construction supervision.

5. RECOMMENDATIONS

5.1 CONSTRUCTION SUPERVISION MANUAL

The aforesaid weaknesses in project implementation may be overcome if the supervisory staff had available a project specific construction supervision manual for guidance during the execution stage of projects.

Since each project has different characteristics it may not be possible, or feasible, to develop a rigid Construction Supervision Manual that can be used for all projects. Instead the objective should be to develop a model document which can be amended to suit each specific project. Many of the items would no doubt be the same for all projects with allowances for variations to suit specific projects.

The Construction Supervision Manual should describe the organizational and operational structure of the Construction Supervisory Engineer and his staff, most of whom are engaged in either in the executing wing of the PWD or by the appointed Supervision Consultants. The Manual should present the general procedures and guidelines to be followed by the organization in carrying out various aspects of the construction supervision tasks related to the implementation of the contract works.

The Construction Supervision Manual should, therefore, delineate organizational responsibilities, lines of communications, regulations, and limitations of authority of the supervision staff. The Manual should also include procedures for carrying out tasks related to inspection, testing, reporting, and general correspondence. Although the existing documentation provides standard procedures for dealing with contractual issues, such as variation orders and time extensions that arise during implementation of the works, it does not deal with the day to day technical requirements, nor does it propose solutions to technical problems, since these technical issues should be covered by the Specifications and other Contract Documents.

Every endeavour should be made to develop a Construction Supervision Manual so that adherence to its guidelines will result in efficient, safe, reliable and consistent supervision of the works in strict conformance to the Specification and other contractual requirements.

The basic framework of the manual should relate to construction supervision procedures consistent with standard practices for highway strengthening, widening, and new construction in conformance those at the national level as dealt with by MORT&H, IS and IRC.

It is vital that all users of the Manual understand that the Contract Documents, including the Specification, are legally binding on all parties and are therefore the controlling documents for the construction supervision process.

All construction supervision staff assigned to the projects should use the Construction Supervision Manual.

The Construction Supervision Manual is to be used as a guide by field personnel. The Manual is not a set of specifications. Its purpose is to clarify the Standard Specifications and to suggest uniform procedures in the highway construction field work. The Standard Specifications, Supplemental Specifications, plans, proposals, special provisions and all supplementary documents are all legally binding parts of the Contract. Nothing in the Construction Supervision Manual should change a contract. The Construction Supervision Manual must be compatible with, and complimentary to, the Conditions of Contract, Specification, and other Contract Documents.

5.2 STRUCTURE OF CONSTRUCTION SUPERVISION MANUAL

The structure of Construction Supervision manual should comprise of following:

1. Organizational Structure of the appointed Supervisory Engineer

Organizational chart of the PWD personnel involved in implementation and supervision of the project is presented under this section.

2. Roles and functions of various officials in the project hierarchy

The functions of the designated 'Engineer' in terms of civil construction contract and supervisory staff of PWD along with the tasks and work activities which he is require to perform are highlighted here.

3. Supervision Guidelines and procedures

This section mainly deals with following aspects:

- Internal and External Communications (letters)
- Office administration - filing system and records
- Works Requests (Inspection/Approval Request Forms)
- Work order book - Site instructions
- Site Inspections, Daily Reports, and Diaries
- Mechanical Plant and Machineries
- Contractor's personnel
- Weather records
- As built drawings
- Final Documentation for Project completion

4. Variation Orders

5. Surveying guidelines and procedures

6. Quantity Survey guidelines and procedures

7. Quality Assurance and Quality Control Guidelines and procedures

- 8. Environmental monitoring**
- 9. Methodology or Method Statement as set out in Clause 115 of MORT&H Standard Specifications.**
- 10. Sequence of Work, Programme, as set out in Clause 115 of MORT&H Standard Specifications.**
- 11. Performa and forms to be used in Execution of works Check lists**
- 12. Labour regulations and laws**
- 13. Work zone safety**
- 14. Traffic Management**

6. ACTION PLAN

The indicative Action plan to develop a Construction Supervision Manual for UP PWD is given below:

- a. Form a fully resourced dedicated cell manned by Senior PWD Engineers, conversant with and experienced in contract management, charged with developing a Construction Supervision Manual
- b. Provide training to the personnel mobilized in the cell.
- c. Develop a model Construction Supervision Manual for Road Project.
- d. Provide training in its use and application to all Supervisory Engineers.
- e. Test the use of this Manual on selected construction works on pilot project basis.
- f. Based on feedback received from the pilot projects revise or modify the Construction Supervision Manual.

7. RESOURCES

The following resources are proposed for developing the Construction Supervision Manual.

7.1 PERSONNEL

Chief Engineer (Quality Management) –as Head of Cell (part-time)

Superintending Engineer – as Deputy Head of Cell (full-time)

Executive Engineer - 2 No.

Clerk

Computer Operator

Office Boy

7.2 FACILITIES

- Accommodation - fully furnished office accommodation - 150 sqm.
- Office Equipment:
 - i. Desk top Computers – 4 No.
 - ii. Printer
 - iii. Photocopier
 - iv. Scanner
 - v. Telephones - 2 No.

8. PROCEDURE FOR IMPLEMENTATION

Development of Construction Supervision Manual should be the responsibility of the Cell created especially for this task. It is anticipated that this work will be completed in 6 months assuming that the Cell is fully resourced. However training, implementation, and any subsequent revisions to the Manual are not included in this 6 month period.

Immediately after creation of the Cell the personnel for efficient functioning of the cell staff should be deployed. All the technical staff deployed in the Cell should be required to satisfactorily complete a training programme.

The Cell would obtain necessary feedback from the field staff, i.e. EE/AE /JE, about the difficulties and problems faced by them during project execution. A period of 3 months, following completion of the prescribed training programme, is probably adequate for development of the Construction Supervision Manual.

In conjunction with the HRD and Training Unit the Cell should also develop a training module for field personnel undertaking Construction Supervision of works as per guidelines contained in construction supervision of work.

On completion of training of selected field personnel of PWD the cell created for development of Construction Supervision manual should be disbanded with the training programme becoming part of the standard training programmes run by the HRD and Training Cell.

The activity of conducting construction supervision of projects on pilot basis in accordance with the guidelines set out in the Manual would be performed by the field staff under the guidance of the Quality Management Cell. Any revisions or modifications felt necessary on the basis of feedback obtained on pilot project would be undertaken by Quality Management Cell.

9. IMPLEMENTATION SCHEDULE

The implementation schedule is given in Figure No. 1.

Figure No. 1 : Implementation Plan

Ref. No.	Description	Year	2008												2009												
		07	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	Create cell for preparation of Construction supervision manual		1	2																							
2	Provide training to the personnel mobilized in the cell			1	2																						
3	Develop Model Construction Supervision manual					4	5	6																			
4	Implement Manual on Pilot Projects								7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
5	Analyse feedback from Pilot Projects										9	10	11	12	13	14	15										
6	Revise/Modify Construction Supervision Manual																	16	17								
7	Develop Training Programmes for all Supervisory Staff						4																				
8	Write/Develop training material							5	6																		
6	Training to the supervisory staff										7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

10. FINANCIAL IMPLICATIONS

Financial estimates for preparation of construction supervision manual are projected in Table No. 1 as given below. It should be noted that the estimates given in Table No. 1 do not include office accommodation or costs of furnishing same.

It is assumed that the Out-sourced Specialist appointed to the Quality Management Unit will oversee this work.

Table No. 1 : Estimates for preparation of construction supervision manual

Ref. No.	Description	No.	Duration	Monthly Cost (in Rs.)	Total Cost (in Rs.)
A	PERSONNEL - Staff Resources				
1	Chief Engineer - from Quality Management Unit	1	1	0	0
2	Superintending Engineer – Head of Cell	1	6	55,000	330,000
3	Executive Engineer	2	6	50,000	600,000
4	Clerk	1	6	15,000	90,000
5	Computer Operator	1	6	15,000	90,000
6	Office Boy	1	6	8,000	48,000
	Sub-Total Resources (A)				1,158,000
B	OFFICE EQUIPMENT				
7	Desk top computer (hire charges)	4	6	2,000	48,000
8	Printer (hire charges)	1	6	1,000	6,000
9	Photocopier (hire charges)	1	6	3,000	18,000
10	Scanner (Lump sum)			5,000	5,000
11	Telephone	2	6	1,500	18,000
12	Networking	1		24,000	24,000
13	Stationery, etc, including running costs	1	6	20,000	120,000
	Sub-Total Office Equipment (B)				259,000
C	TRANSPORTATION				
14	Vehicle (hire charges)	1	6	25,000	150,000
15	Travel Allowances				50,000
	Sub-Total Transportation (C)				200,000
Total A +Total B +Total C					1,617,000

The estimated cost for production of Construction Supervision Manual and associated training material is Rs.1, 617,000 or 16.17 lacs.

11. FOCUS GROUP MEETING

The Focus Group meeting was convened on 18th and 19th February 2008.

In the meeting held on 18th February 2008 the following members participated:

Participants from PWD

Mr. Virendra Yati	Superintending Engineer
Mr. Vinod Chandra	Director Research
Mr. Tirath Raj	Executive Engineer
Mr. Anaya Kumar Srivastava	Assistant Engineer

Participants from TA Consultant

Mr. Alan Stanbury	Team Leader
Mr. S.K. Pancholy	Procurement Specialist

On 19th February 2008 a meeting was held with chairman Focus Group, the following members were present:

Participants from PWD

Mr. D. V. S. Sarawat	MD UPSBC
Mr. Goyal	UPSBC

Participants from TA Consultant

Mr. S.K. Pancholy	Procurement Specialist
Miss Janhabi Shome	Environment and Social Specialist

1. The Focus Group (FG) members opined that a standard Construction Supervision (CS) manual which can provide guidelines to the supervisory engineers of the department should definitely be in place. The FG members pointed out that the methodology for some of the work items is already available with UP PWD, which should be included in the proposed Construction Supervision manual.
2. FG desired that the CS manual should define the task and responsibilities for all the supervisory engineers of the PWD including the designated 'Engineer'.
3. The FG was of the view that the CS manual should include the task and responsibilities of supervisory engineers in respect of quality assurance measures, recording and checking of measurements of work done by the contractor.

4. The TA Consultant is in agreement with the opinion of the FG members. While preparing the Construction Supervision Manual the views of FG member should be incorporated by the cell responsible for preparing the manual.
5. The FG approved the draft of Report No.32 therefore this is issued as a Final Report.

12. PRESENTATION TO PROJECT STEERING COMMITTEE

Report No. 32 - Implement new works supervision processes, guidelines and practices

PWD Focus Group - I

D.V.S. Sarawat	MD UPSBC
Surendra Kumar	Jt. M.D., U.P. State Bridge Corporation, Lucknow
Arun Kumar	EE, CD-1, Aligarh
Rajan Mittal	EE, PD, Saharanpur
Anurag Asthana	AE, UPRRDA, Lucknow
Navin Kumar	AE, TY. DCU (NH), Lucknow
Anay Kumar Srivastava	AE, IDS Cell, Lucknow
Sandeep Saxena	AE, IDS Cell, Lucknow

LEA International Ltd. & LEA Associates South Asia Pvt. Ltd.

S.K. Pancholy Contract & Procurement Specialist



Report No. 32 - Implement new works supervision processes, guidelines and practices

Background:

IDS Consultant's (TCE) Recommendation:

Construction Operation and Supervision

“Strengthen the Construction process by introducing new technologies, systematic construction supervision and independent Quality Audits and Controls”

Objective of Technical Assistance under implementation reforms:

“Strengthen PWD role and capability in the Supervision of Works”

Action Milestone targeted by Government of UP:

“Implement new works supervision guidelines and practices”



Report No. 32 - Implement new works supervision processes, guidelines and practices

Purpose and Action Plan

Purpose:

Frame needful guidelines for developing a model construction supervision manual.

Action Plan:

1. Overview of prevailing guidelines and practices for construction supervision of works in UP PWD.
2. Identify weaknesses in the existing system
3. Suggest measures to improve the supervision processes and guidelines



Report No. 32 - Implement new works supervision processes, guidelines and practices

Overview of Prevalent Practices

Construction Supervision based on Circulars and Government orders relating to administration, specifications and planning aspects. Manual for Construction Supervision does not exist.

Manual of Orders

Elaborates the financial aspects of works and standardization of form often used is done. However, profoma and forms in respect of technical matters have not been standardized.



Report No. 32 - Implement new works supervision processes, guidelines and practices

(Over view Continued...)

Supervisory Engineers discharges responsibility of construction supervision based on:

- experience,
- subjective judgement,
- guidelines given by superiors,
- contract document including Specifications, bill of quantities and drawings;

The World Bank Funded Projects

Construction Supervision manual developed by the Construction Supervision Consultants.

PMGSY

Operational Guidelines published by GOI for monitoring and supervision of works.



Report No. 32 - Implement new works supervision processes, guidelines and practices

Weaknesses in the Existing System:

1. Elaborate guidelines or manual regarding construction supervision of works at field level does not exist.
2. Invoicing and discharging payments to the contractors is cumbersome and time consuming needs simplification and standardization.
3. Methodology of work items or method statement is not developed
4. Lack of Training to the supervisory engineers.



Report No. 32 - Implement new works supervision processes, guidelines and practices

Recommendations

Develop a model construction supervision of works manual.

The structure of Construction Supervision manual shall comprise of:

1. Organizational structure of the supervisory Engineer
2. Roles and functions of various officials in the project hierarchy.
3. Supervision guidelines and procedures
4. Variation orders
5. Surveying guidelines and procedures



Report No. 32 - Implement new works supervision processes, guidelines and practices

Recommendations (Contd...)

6. Quantity Survey guidelines and procedures
7. Quality assurance and Quality Control guidelines and procedures
8. Environmental monitoring
9. Methodology or methods statements of works items.
10. Sequence of work and programme
11. Performa and forms used in works and checklists
12. Labour regulations and laws
13. Work Zone Safety
14. Traffic Management



Report No. 32 - Implement new works supervision processes, guidelines and practices

Action Plan

- a) Form a fully resourced cell manned by Senior PWD Engineers for developing Construction Supervision manual.
- b) Provide training to official deployed in the cell
- c) Cell to Develop Construction Supervision manual
- d) Provide Training to supervisory engineers on use and application of manual
- e) Test the use of manual on selected Construction works on pilot project basis
- f) Revise the manual on basis of feedback obtained from pilot project.



**Report No. 32 - Implement new works supervision processes,
guidelines and practices**

Resources:

Personnel:

CE (QM) – Part time

SE – Full time

EE- Full time 2 No

Ancillary staff

Facilities:

Fully furnished and equipped office



Report No. 32 - Implement new works supervision processes, guidelines and practices

Procedure for Implementation

Construction Supervision Manual shall be developed by the PWD cell created for this purpose. The implementation of construction supervision manual on pilot project will be under taken by the concerned Divisional Engineer.

Total time period for development of Construction Supervision manual shall be 6 months.



**Report No. 32 - Implement new works supervision processes,
guidelines and practices**

Cost Estimates: Rs.17.00 lacs

