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Research Paper

ANALYSIS OF QUALITY INSPECTION REPORTS OF NATIONAL QUALITY MONITORS FOR PMGSY ROADS IN INDIA

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An attempt has been made in present study to analyze inspection reports of National Quality Monitors (NQMs) of the rural roads constructed under Pradhan Mantri Gram Sadak Yojana (PMGSY) scheme in different states of India during the period of November 2010 to March 2012. Further, an attempt has also been made to find out the rankings of critical items such as Earth work and Sub-grade, Sub-Base, Base Course and Bituminous Layer contributing to Unsatisfactory (U) overall grading of road works. The study also includes finding the rankings of sub-items within these items contributing to U overall grading of these Items. The data of NQM Inspection Reports has been taken from the website of National Rural Roads Developing Agency (NRRDAs) and detail analysis has been carried out for finding of the rankings of Items/Sub-Items contributing to U grading of road works and respective Items. The study results will be very useful in deciding the appropriate strategy for quality improvement priorities amongst different Items/sub-items and for the rural road works constructed under Pradhan Mantri Gram Sadak Yojana (PMGSY) scheme in India.

Keywords: PMGSY, National Quality Monitors (NQMs), Rural roads, Grading, Unsatisfactory (U), Satisfactory (S), Requires Improvement (RI)

INTRODUCTION TO PMGSY SCHEME IN INDIA

The primary functions of transportation include mobility, connectivity and accessibility. Road transport in general and rural transport in particular provides door to door service, thus ensures accessibility to nooks and corners of the country. It has been realized that the absence of All Weather Road Connectivity is a major impediment in the development of rural areas, since lack of access results in isolation and remoteness of rural masses and thereby depriving them of opportunities of employment, healthcare, education, etc. Over and above, lack of connectivity increases the vulnerability of such communities during events of natural

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disaster. Government of India, having realized that providing rural accessibility serves as a means for poverty alleviation, launched Pradhan Mantri Gram Sadak Yojana (PMGSY) as a fully funded centrally sponsored plan on December 25, 2000, with the primary objective of providing all weather road connectivity to all habitations with a population of 500 and above in plain areas. In respect of the Hill States (North East, Sikkim, Himachal Pradesh, Jammu & Kashmir, Uttarakhand), the desert areas (as identified in the Desert Development Program), the Tribal (Schedule-V) areas and in Left Wing Extremism affected/Integrated Action Plan (IAP) districts as identified by the Ministry of Home Affairs/Planning Commission, the objective is to connect habitations with population of 250 persons and above.

PRESENT IMPLEMENTATION STATUS

Connectivity to total 77,877 new habitations and corresponding all weather roads length measuring 3,19,438 km length had been constructed in different states of India under PMGSY scheme up to the end of March 2011, since the inception of the PMGSY scheme in year 2000.

THREE TIER QUALITY CONTROL MECHANISM FOR RURAL ROAD CONSTRUCTION UNDER PMGSY SCHEME

PMGSY Guidelines emphasize upon quality cantered implementation strategies and recognize quality as essence of the program. To bring execution of the program to the desired high quality standards, a three tier quality management mechanism has been institutionalized under PMGSY. The first tier of this mechanism is in-house quality control at Program Implementation Unit (PIU) level. The second tier is a structured independent quality monitoring at the State level. Under the third tier, independent National Quality Monitors (NQMs) are deployed by National Rural Roads Developing Agency (NRRDA) for inspection of road works at random not only to monitor quality but also to provide guidance of senior professionals to the field functionaries. The NQMs are senior engineers retired from the State Governments or Government of India organizations, empaneled on the basis of the criteria fixed by NRRDA. The NQMs are required to inspect the rural road works are being constructed under PMGSY scheme and record their quality regarding observations as per the prescribed guidelines. The guidelines for NQM inspections have been made objective and based on defined methods of observation including clarity on actionable points. Guidelines for photographic recording of inspections by NQMs have also been prescribed. To ensure effective and uniform reporting of the quality issues, orientation programs are organized for NQMs.

PROCEDURE FOR NQM INSPECTIONS OF RURAL ROAD WORKS

The objective of third tier of Quality Monitoring under PMGSY, i.e., inspection of rural road works by national level independent monitors is to identify shortcomings in respect of quality of road works and to guide the PIUs about the specifications, good practices and effective execution of works with desired quality. The role of these monitors is to critically examine

the road works and give feedback about quality of road works and quality management related shortcomings to the State level quality management team and NRRDA to enable systemic improvements.

There could be many methods of inspecting, making observations and evaluating various items and sub-items involved in construction of a rural road. With a view to achieve uniformity, objectivity in observations and evaluation, the efforts have been made to standardize the methods of observations and evaluation. Various items and sub-items involved in construction of a rural road have been listed in Annexure 3 of Draft Guidelines for Quality Monitoring for National Quality Monitors under Third Tier of Quality Mechanism published by NRRDA. Each of the sub-items defined under the Item shall be examined by NQM as per prescribed method of observation and frequency. The quality of the sub-item/item would be quantified in one of the grades prescribed as Satisfactory(S)/Unsatisfactory (U)/ Requires Improvement (RI). The NQM shall base his observations on the method of field tests, hand feel tests, measurements and visual observations as specified only and in no other way. The NQM is expected to traverse through the entire road length to ascertain the quantum of work such as length of road, number of Cross Drainage works (CDs), protection works, side drains, catch water drains, rigid pavement and other aspects of the work. After the traverse, the NQM would decide about the locations for detailed observations. The quality of every item and sub-item of work would be evaluated by the NQM on the basis observations made as per prescribed standard method. The grading would be recorded for every item and abstracted at appropriate space provided in the format. The grading of work would be done with an intention to quantify the observations showing level of satisfaction in relation to the specification of the work/item under observation. The objective would be to indicate to the executing agency, as to whether the material or workmanship is acceptable, or unacceptable. If the item is unacceptable, the improvement could be done by either replacement of the entire material/portion of work or by rectification in workmanship or material. The grading should be able to indicate to the PIU/ State, the level of intervention required for improvement. Therefore, based on the type of item and method of observation, each item/sub-item of work would be graded in any of the categories, i.e., 'Satisfactory (S)'or 'Requires Improvement (RI)' or 'Unsatisfactory (U)'. Based on grading, the PIU shall take action for rectification of defect, therefore, it is very important to record the defect as well as the suggestive method by which the rectification could be done. The NQM shall record, the grade as well as clear and express reasons for grading the item of work as 'RI' or 'U' along with his suggestions for improvement. The reasons and suggestions shall be recorded clearly in such a way that there are no ambiguities or contradictions with observations in other items. The details of typical NQM quality recording format for important items such as Item 4- Earth work and Sub-grade, Item 5-Sub-Base, Item 6-Base Course and Item 7-Bituminous Layer alongwith their sub-items are given in Table 1.

Table 1: Statement Showing Item Wise Observations, Their Method, Frequency and Awardable Quality Grading for Item 4,5,6 and 7

S. No.	Sub Item for Observation	In Case of Work	Method of Observation	Frequency	Grades
1	2	3	4	5	6
Item 4-Earth Work and Sub-grade in Embankment/Cutting					
A	Quality of Material for Embankment/Sub-grade	Ongoing or completed	Visual classification of Soils	1 per km	S/U
B	Compaction		Field Density Test by sand replacement/core-cutter method	1 per km	S/U
C	Side Slopes and Profile	Complete	Measurement	4 Observations per km	S/U
D	Stability and Workmanship of Cut Slopes (in case of hilly/ rolling terrain)	Ongoing or completed	Visual Observation	4 per km	S/U
E	Adequacy of Slope Protection (in case of high embankments/ hilly/rolling terrain)		Visual Observation	4 per km	S/U
				Item Grade	S/U
Item 5- Sub-Base course					
A	Grain Size	Ongoing or completed	Gradation Test	1 per km	S/U
B	Plasticity		Hand feel test of ball making with moisture content	1 per km	S/U
C	Compaction	Ongoing or completed	Field Density Test by sand replacement/core-cutter method	1 per km	S/U
D	Total Thickness of Layer	Ongoing or completed	Measurement by taking pit for full layer thickness	1 per km	S/U
				Item Grade	S/U
Item 6- Base Course- Water Bound Macadam					
A	Grain size of Course Aggregate	Ongoing or completed	Gradation Test	1 per km	S/U
B	Plasticity of Crushable Aggregate used as fillers		Hand feel test of ball making with moisture content	1 per km	S/U
C	Adequacy of Compaction through volumetric analysis		Hand feel test by digging pit and volumetric analysis	1 per km	S/U
D	Thickness of every layer of WBM		Actual measurement by taking pit	1 per km	S/U
				Item Grade	S/U

Table 1 (Cont.)

S. No.	Sub Item for Observation	In Case of Work	Method of Observation	Frequency	Grades
1	2	3	4	5	6
Item 7- Bituminous Layer- Premix Carpet (PMC)/ Surface Dressing (SD)					
A	Gradation of Aggregate	Ongoing	Grain size analysis (Gradation Test)	1 at Hot-Mix plant/1 per km	S/U
B	Mixing Temperature of Mix	Ongoing	Measurement of temperature by thermometer	1 at Hot-Mix plant	S/U
C	Laying Temperature of Mix	Ongoing	Measurement of temperature by thermometer	1 where laying is in progress	S/U
D	Thickness of layer	Ongoing or completed	Measurement by taking pit	2 per km	S/U
E	Surface Evenness	Ongoing or completed	By straight edge	2 per km	S/U
				Item Grade	S/U

METHODOLOGY FOR SUB-ITEM/ ITEM WISE GRADING AND OVER-ALL GRADING OF WORK

The sub-item wise grading of every item of work would be entered in the reporting format and the item grading would be the lowest of the grading of sub-items within that item. If, any of the items in Item no. 4, 5, 6 and 7 are graded as 'U', overall grading of the work shall be 'U' i.e., 'Unsatisfactory'. If, all the items given in above four items are 'S' but grading in any of other items is 'U' or 'RI', the overall grading of work shall be 'S-RI', i.e., Satisfactory but Requiring Improvement. If grading of all items is 'S', the overall grading of work shall be 'S' i.e., 'Satisfactory'.

SCOPE OF PRESENT STUDY

The scope of present study includes analysis of quality inspection reports for the inspections carried out by NQMs during the period of November 2010 to March 2012 for road works constructed under PMGSY scheme in different states of India. An attempt has been made in present study to analyze 4077 number of total NQM inspection reports during the same period in detail and to find out the rankings of important items such as Item 4 – Earth work and Sub-grade, Item 5 – Sub-Base, Item 6 – Base Course and Item 7 – Bituminous Layer contributing to Unsatisfactory overall grading of works. Similarly, an attempt has also been made to find out the rankings of sub-items within these items, contributing to Unsatisfactory grading of the items. All the data has been collected by accessing the National Rural Roads Developing Agency's website 'omms.nic.in' wherein the details of each inspection reports of NQMs are available.

DATA ANALYSIS AND STUDY RESULTS

The analysis has been carried out in different stages to find out rankings of important items/ sub items such as Item 4-Earthwork and Sub-grade in Embankment/Cutting, Item 5-Sub-base, Item 6-Base course-Water Bound Macadam and Item 7-Bituminous Layer based upon their contribution in the overall Unsatisfactory Grading (U) of road works and Items as below:

i. To find out share of important Items/sub items with respect to Unsatisfactory Grading (U) to Total number of NQM Inspections.

ii. To find out share of important Items/Sub Items with respect to Unsatisfactory Grading (U) to Total number NQM Inspections

Table 2: Share of Important Items/ Sub Items With Respect to Unsatisfactory Grading (U) to Total Number of NQM Inspections

Analysis Details	Level of Analysis	Analysis Results Expressed in Terms of Percentage
Total No. of Inspections by NQMs (4077 Nos.) ↓ No. of NQM Inspections with U Grading (18.56 %) ↓ Item 4 (5.74%) — Item 5 (6.55%) — Item 6 (11.36%) — Item 7 (3.56%) ↓ IR_3 — ↓ IR_2 — ↓ IR_1 — ↓ IR_4 Sub Item 4A (0.49 %) ***SIR^5*** Sub Item 4B (3.51 %) ***SIR^1*** Sub Item 4C (1.94 %) ***SIR^3*** Sub Item 4D (2.33 %) ***SIR^2*** Sub Item 4E (1.67 %) ***SIR^4*** Sub Item 5A (4.00 %) ***SIR^1*** Sub Item 5B (1.59 %) ***SIR^4*** Sub Item 5C (2.77 %) ***SIR^2*** Sub Item 5D (2.70 %) ***SIR^3*** Sub Item 6A (9.47 %) ***SIR^1*** Sub Item 6B (1.57 %) ***SIR^4*** Sub Item 6C (7.48 %) ***SIR^2*** Sub Item 6D (5.05 %) ***SIR^3*** Sub Item 7A (0.83 %) **SIR^3** Sub Item 7B (0.34 %) ***SIR^5*** Sub Item 7C (0.81 %) ***SIR^4*** Sub Item 7D (2.08%) ***SIR^1*** Sub Item 7E (1.94 %) ***SIR^2***	Total Inspections Inspections with U Grading Critical Items with U Grading Sub Items with U Grading	(No. of Inspections awarded U Grading) / (Total NQM Inspections) (No. of Inspections awarded U Grading for Item) / (Total NQM Inspections) ***Ranking of Items contributing U Grading of works*** (No. of Inspections awarded U Grading for Sub Item) / (Total NQM Inspections) ***Ranking of Sub-Items contributing U Grading of Item***

Table 3: Share of Important Items/Sub Items with Respect to Unsatisfactory Grading (U) to Total Number of NQM Inspections with U Grading

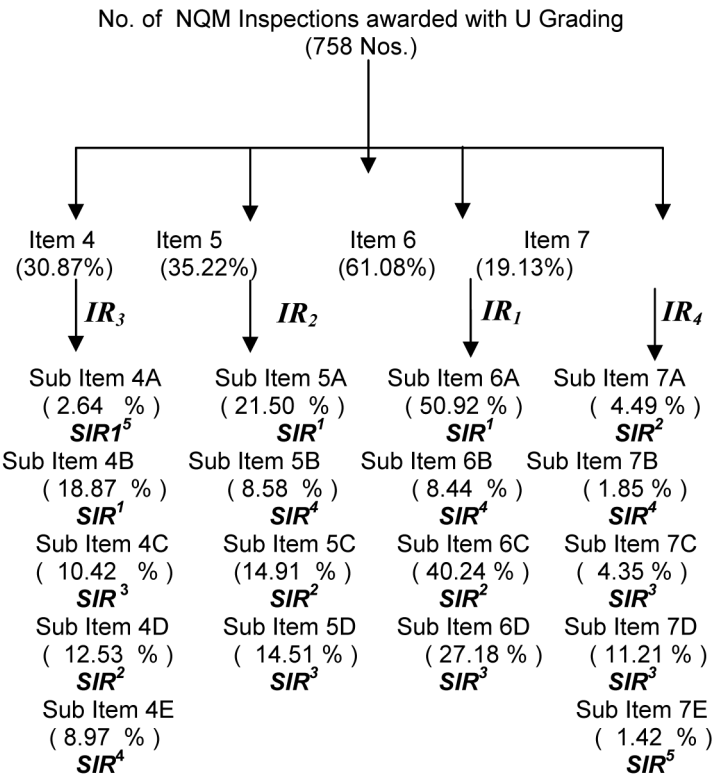
Analysis Details	Level of Analysis	Analysis Results expressed in terms of percentage
	Inspections awarded with U Grading Critical Items with U Grading Sub Items with U Grading	(No. of Inspections awarded U Grading for Item) / (Total NQM Inspections awarded with U Grading) ***Ranking of Items contributing U Grading of works*** (No. of Inspections awarded U Grading for Sub Item) / (Total NQM Inspections awarded with U Grading) ***Ranking of Sub-Items contributing U Grading of Item***

Table 4: Share of various Sub Items Contributing to Overall Unsatisfactory (U) Grading for Item 4-Earthwork and Sub-grade in Embankment/Cutting

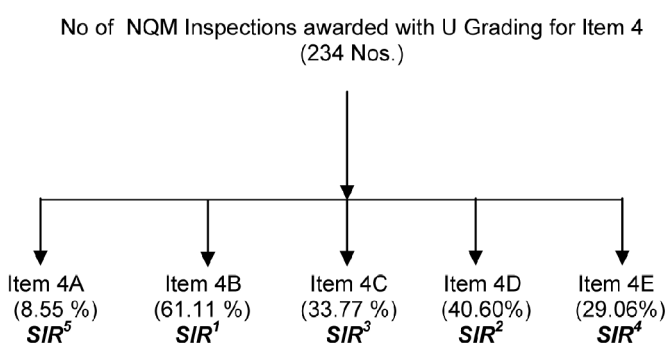
Analysis Details	Level of Analysis	Analysis Results expressed in terms of percentage
	Inspections awarded with U Grading for Item 4 Sub Items of Item 4 with U Grading	(No. of Inspections awarded U Grading for Sub Item) / (Total NQM Inspections awarded with U Grading for Item 4) ***Ranking of Sub-Items contributing U Grading of Item***

Table 5: Share of Various Sub Items Contributing to Overall Unsatisfactory (U) Grading for Item 5-Sub-base Course

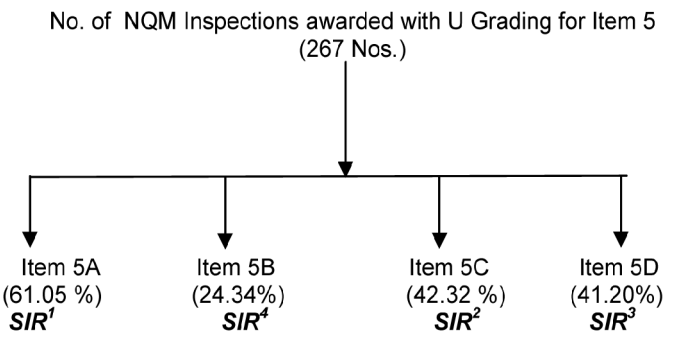
Analysis Details	Level of Analysis	Analysis Results expressed in terms of percentage
	Inspections awarded with U Grading for Item 5 Sub Items of Item 5 with U Grading	(No. of Inspections awarded U Grading for Sub Item) / (Total NQM Inspections awarded with U Grading for Item 5) ***Ranking of Sub-Items contributing U Grading of Item***

Table 6: Share of Various Sub Items Contributing to Overall Unsatisfactory (U) Grading for Item 6-Base-Course

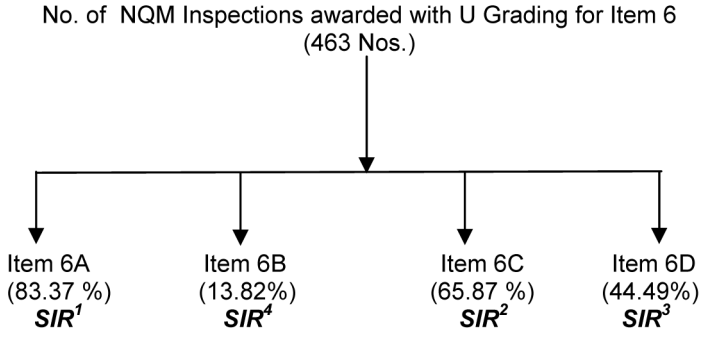
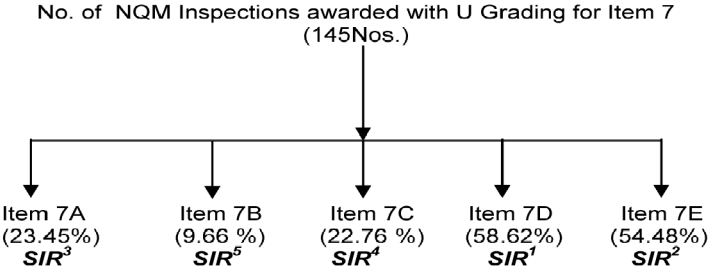
Analysis Details	Level of Analysis	Analysis Results expressed in terms of percentage
	Inspections awarded with U Grading for Item 6 Sub Items of Item 6 with U Grading	(No. of Inspections awarded U Grading for Sub Item) / (Total NQM Inspections awarded with U Grading for Item 6) ***Ranking of Sub-Items contributing U Grading of Item***

Table 7: Share of various Sub Items contributing to overall Unsatisfactory (U) Grading for Item 7-Bituminous Layer

Analysis Details	Level of Analysis	Analysis Results expressed in terms of percentage
	Inspections awarded with U Grading for Item 7 Sub Items of Item 7 with U Grading	(No. of Inspections awarded U Grading for Sub Item) / (Total NQM Inspections awarded with U Grading for Item 7) ***Ranking of Sub-Items contributing U Grading of Item***

awarded with Unsatisfactory (U) overall Grading.

iii. To find out share of various Sub items contributing to overall Unsatisfactory (U) Grading of different Items.

iv. To rank different Items/sub items contributing to Unsatisfactory (U) grading.

An analysis has been carried out for different stages as mentioned above and the analysis results along-with Item Rankings (IR) contributing overall Unsatisfactory (U) grading of work as well as Sub-Item Ranking (SIR) contributing overall Unsatisfactory (U) grading of Items are given in Tables 2 to 7.

CONCLUSION

The following conclusions are drawn from the study results:

i. The quality of Item 6 Base course-water Bound Macadam contributing the highest while the quality of Item 7 Bituminous Layer contributing least for Unsatisfactory (U) overall grading of works amongst the Items considered in the study.

ii. The quality of Sub-Item 4B Compaction contributing the highest while the sub-item 4A Quality of Material for Embankment/ Sub-grade contributing least for Unsatisfactory (U) overall grading of Item 4 Earth work and Sub-grade in Embankment/ Cutting amongst the different sub-items.

iii. The quality of Sub-Item 5A Grain size contributing the highest while the quality of sub-item 5B plasticity contributing least for Unsatisfactory (U) overall grading of Item 5 sub-base course amongst the different sub-items.

iv. The quality of sub-item 6A grain size of course aggregate contributing the highest while the quality of sub-item 6B plasticity of crushable aggregate used as filler contributing least for Unsatisfactory (U) overall grading of Item 6 base course-Water Bound Macadam amongst the different sub-items.

v. The quality of sub-item 7D Thickness of Bituminous Layer contributing the highest while the quality of sub-item 7C Laying Temperature of mix contributing least for Unsatisfactory (U) overall grading of Item 7 Bituminous Layer Premix Carpet (PMC)/Surface Dressing (SD) amongst the different sub-items.

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