QUALITY CHECK OF ASIAN DEVELOPMENT BANK FUNDED FARM-TO-MARKET ROADS - PHASE-I PROJECT

NATIONAL TRANSPORT RESEARCH CENTRE

GOVERNMENT OF PAKISTAN

MINISTRY OF COMMUNICATIONS

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35

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NTRC - 235

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EXECUTIVE SUMMARY

The quality and durability of highways, roads and streets has always been a major concern to highway engineers through out the world. Controlling the quality of road construction is the prime responsibility of highway agencies. However in developing countries like Pakistan, systems have yet to be established where the overall highway construction quality could be improved by using latest management techniques.

National Transport Research Centre (NTRC) during past few years, has devoted great deal of efforts to determine the roat-cause(s). The research has revealed that the primary reasons of premature failures of our highways and roads are: (a) Lack of experienced personnel; (b) Large volume of materials that are being handled without proper equipment; and (c) Poor coordination among the clients, consultant and contractors.

The Asian Development Bank has assigned to the National Transport Research Centre a study of Economic Impact of the Farm-to-Market roads being constructed in various districts of NWFP, Punjab, Sindh and Balochistan provinces during Phase I. During the course of preliminary survey to select the roads for the study, visual observations were also made on subgrade, subbase, base and surface courses with regard to the quality of

construction. Particular attention was paid to the method of construction equipments used and availability of qualified and experienced staff. Standard AASHTO method slightly modified for Farm-to-Market roads were used in order to rate the riding quality of the completed road sections. Stability of shoulders on either side of the roads were also examined critically. A brief summary of the findings is as follows:

i) Materials used for embankment construction in all the four provinces seems to be of low specifications i.e. generally of high plasticity index. This type of material has a greater tendency to deform easily when saturated or dried up thus creating tremendous amount of distress on the pavement surface.

ii) Poorly graded hand broken water bound macadam were used for base course in all the four provinces which causes seggregation and may end up with various forms of distress in the pavements.

iii) In water logged areas, steep embankment slopes of 1:2 were observed which has lot more chances of failure. This should be at least 1:3 and preferably 1:4.

iv) Non-uniform spreading of surface aggregate were noticed in all the provinces.

v) Various rain cuts and errosions were observed on the shoulders especially in Punjab province.

vi) The riding quality of the completed pavement in the Sindh province were very good.

vii) Riding quality of the completed sections in Punjab, NWFP and Balochistan Provinces were found to be fair.

Since the road constructed with low specifickation will deteriorate much earlier than the design life, the following points are recommended in order to improve quality control:

i) Well graded granular materials may be used in base course in order to avoid the problem of seggregation.

ii) Special attention needs to be given to the compaction of shoulder on either sides of the roads to avoid rain cuts and errosions of the shoulder materials.

iii) Mechanical chips spreader may be used for surfacing aggregate.

This study is not intended as an indicement of any particular agency. The main objective is to evaluate the quality of construction and bring it into the notice of the concerned authority to enable them to take remedial measures.

QUALITY CHECK OF ADB-FUNDED FARM-TO-MARKET ROADS - PHASE-I PROJECT

I. INTRODUCTION

Quality control of construction work is basically the measure to ensure conformity and to control the job in order to achieve the end product in accordance with the specified criteria setforth in the construction documents generally known as the construction specifications and/or standards.

National Transport Research Centre while carrying out the reconnaissance survey of the Asian Development Bank funded Farm-to-Market Roads included in the Phase-I of the project in eleven districts of all the four provinces also conducted the quality check of the same.

This preliminary sort of investigation was made through visual observations on completed and/or under construction FM roads. These investigations were made on subgrade, subbase, base and surface courses. Shoulders on either sides of the roads were also checked critically. The observations were made with respect to the construction practices adopted by the contractors, availability of the proper equipments and qualified and experienced staff.

Beside observing quality of construction, riding quality of the completed sections were also checked using a standard Toyota Hilux pickup driving at normal speed limit in day light. Roads that were checked for riding quality were rated on

the basis of scores on a scale of (0-10), zero being the worst and ten being the excellent on a standard AASHTO rating card specially modified for the Farm-to-Market roads project.

II. LIST OF THE VISUALLY OBSERVED FARM-TO-MARKET ROADS

The following road sections of Farm-to-Market - Phase-I were visually observed to check the quality of construction:

Province	District	Code No.	Road Section From	-	To
NWFP	Peshawar	242	Shakh No. 4	-	Zarbab
		244	Panjago	-	Darmaangai
		245	Daulatpura	-	Sadasar
		247	Hamid Machin	-	Aza Khel
	Mardan	224	Showki Killi	-	Roghan
		225	Jamal Ghari	-	Centre Pirabed
		226	Jamal Ghari	-	Sawaldher
		227	Sh Killi Ck.	-	Palo Dheri
	Bannu	201	Bannu DIK Rd	-	Sarga Khel
		203	Sarga Khel	-	Asghar
Punjab	Sheikhupura	367	Thabal	-	Maha Devi
		365	Phullarwana Ck	-	Khangah Dogran
		364	Sh'kot/Nank Rd	-	Shahkot/J'wala
		362	M'wala/addag Larry	-	Sh'kot N'kana
	Sargodha	345	Shaheenabad	-	Chak 130/nb
		343	Chak Miana	-	Lakseen (c)
		342	Midh Ranjha	-	Hujjan Road
	Faisalabad	308	Chak 115/Jb	-	Jhumra/chnt Rd.
		301	Chak 144/rb	-	Chak 24/Jb
		309	Khirianwala	-	Sangla Hill Road
		303	Chak 247/re	-	Chak 222/rb
		310	Jhoke Ditta	-	Chak 425/gb
		302	Chak 315/gb	-	Jhal Ghorianwala
		312	Chak 444/gb	-	Tandalianwala Shaw Rd
		305	Md'wala/ Mamunkhanjan	-	Chak 200/gb

	T. T. Singh	382	Chak 180/Jb	-	Chak 256/gb
		383	Gojra/Jhang Rd	-	Chak 324/Jb(c)
		385	T.T.Singh	-	Sorkot
		386	Aroti	-	Sandilianwali
		381	Chak 180/Jb	-	Chak 256/Jb
	Jhang	327	Azadpur/ 18 Ghagh	-	Dauranpur
		322	Jalalpur/ Qatalpur Rd.	-	Shorkot/Multan Road
		326	Darbar H'Shah	-	Adda
		323	18 Hazara	-	Wasawa
		321	Jhang Sgdha Rd	-	Bhamb
B'chtan	Nasirabad	104	Rojan Jamali	-	Old Rojhan
Sindh	Jacobabad	403	Jacobabad	-	Baqapur
		404	Noor Wah	-	Bahadurpur via Madapur
		402	Abad	-	Ramzanpur via Khoreja
	Larkana	40502	Bangaldero	-	Lashari
		40512	Ghosul(thoof)	-	Bhand

III. FIELD OBSERVATION

Quality of the On-Going Construction Work:

The criteria for the quality check of the construction of Farm-to-Market roads were two fold and are given below:

1. Quality of stockpile materials,
2. Method of placement.

The quality of the above mentioned FM roads being constructed that were observed visually are described here province-wise:

N.W.F.P: Generally the fill material used for constructing embankment should have a plasticity index ranges between 4-12 percent. In Peshawar district on Road No. 242 that passes from Shakh No.4 - Shakh No.5 - Zarbab, contractor has been using highly expensive fill material that has the properties of a clay soil which is the prime material for causing distresses on the pavement surface. This type of materials has a tendency of expand tremendously with the addition of water. Resident Consultant of the project was informed about the fact and requested to either replace the clayey material with a select fill or modify it by adding and mixing certain percentage of sand to the existing fill materials. Correct percentage of sand can be found by running Sand Series Atterberg Limit Tests on the clayey soil.

Base course stock pile on one of the road i.e. No. 247 from Hamid Machin to Aza Khel has very high percentage of fines which may eventually segregate under the surface course causing pavement structural and/or function failure. The materials brought to the site is poorly graded. This also need to be either replaced or modified with the addition of more coarse particles upto the specified gradation. Other road sections in NWFP does not seems to have that much of the problems.

Generally the construction practice adopted by the contractor are not satisfactory specially the methods

adopted for compaction of various layers. One reason for this is lack of proper equipment and machinery and lack of qualified staff and expertise with the contractor. More importantly, the poor coordination between the consultants and contractors resulted into a low quality product.

Work on shoulders on both sides of the roads (except at restricted sections where there are no shoulders) were done quite satisfactorily and no deterioration has been observed.

Punjab: The overall quality of Farm-to-Market roads construction in the five districts of Punjab namely Sheikhupura, Sargodha, Faisalabad, Jhang and T.T. Singh were also evaluated visually.

The general practice as observed in some of the cases of embankment construction was not satisfactory especially in the district of Jhang and T.T. Singh where the compaction of each layers does not seems to be carried out to the required layer thickness and degree of compaction.

Water bound macadam used in the base course in all the five districts were not graded properly as the gradation process were carried out manually. At various locations fairly large size (larger than +3 inch) materials were used.

Shoulders on either sides of the roads shows poor workmanship and not properly compacted especially in Sargodha and Sheikhupura districts where many rain cuts has

already appeared at various locations. This may lead to an ultimate failure of the shoulders thus causing damages to the pavement.

Sindh: Quality of road construction in Jacobabad districts were found to be good especially the shoulders appears to be of good quality. No damage and/or sign of distress was observed on the entire length of the roads that were choosen for inspection randomly.

In the district of Larkana Farm-to-Market road No. 40502 from Bangaldero to Lashari has fairly good workmanship whereas the quality of work on Farm-to-Market road No.40512 from Ghosul (Thoof) to Bhand does not seems to be satisfactory at the sections where water logging has created great problem, however, the quality seems to be quite satisfactory at rest of the sections on the same road.

Balochistan: Materials used for construction of Farm-to-Market roads in the district of Nasirabad seems to have physical properties within the specified range, however method of placement are not satisfactory due to the lack of equipment. The overall quality of the road No. 104 from Rogan Jamali to Old Rogan is satisfactory. Did not find any deterioration on the shoulders on either sides of the road.

IV. RIDING QUALITY

Riding quality of some of the completed sections of the Farm-to-Market roads in all the four provinces were measured. Although the pavement surface does not show any serious sign of distresses such as cracking, pot holes, wheel ruts, corrugations, bleeding or flushing, however except in Jacobabad district where the pavement riding quality was rated as "Very good" none of the other roads elsewhere has that very high surface rating. Table 1 summarized the rating of the riding quality of the roads in question. Completed sections of the roads that were rated by the expert on the modified rating cards are attached at Annex-A.

The main reasons for the lower rating or comparatively higher riding discomfort are as follows:

1. Non-uniform spreading of the aggregate and binder.
2. Delayed spreading of aggregate normally through a basket, thus delayed rolling and hence inadequate compaction.
3. Less bitumen used.
4. Higher percentage of dust in the aggregate.

Table 1
Riding Quality of FM Roads - Phase I

Province	District	Farm-to-Market Roads	Code	Riding Quality
NWFP	Bannu	Bannu DI Khan Rd.- Sarga Kheru Khel	201	6.0
	Mardan	Jamal Ghari - Centre Pirabad	225	6.0
	Peshawar	Daulatpura - Sadasar	245	5.5
Punjab	Sargodha	Shaheenabad - Chak 130/nb	345	5.0
		Chak Miana-Lakseen	343	6.0
	Sh'pura	Phullarwana Chowk - Khangah dogran	365	6.0
		Manawala/Addag Larry - Shahkot Nankana Road	362	5.0
	Faisalabad	Muridwala/Mamun Khanjan - Chak 200gb	305	6.0
		Chak 144/rb - Chak 24/Jb	301	6.0
	Jhang	Jhang Sargodha Rd.- Bhamb	321	5.0
	T.T.Singh	Dist. boundry - Chak 281/Jb	382	5.0
Sindh	Jacobabad	Jacobabad-Baqapur	403	8.0
	Larkana	Bangaldero-Lashari	40502	8.0
B'chtn	Nasirabad	Usta Mohd-Mirwah	103	5.0

Note: The average values of the riding quality are based on a scale of 0-10, rating cards are attached at Annex-A.

It is suggested that in order to achieve a good quality of pavement surface, aggregate on surface courses, may be spreaded by the use of chip spreader as one developed by NTRC, thus avoiding manual method of spreading aggregates which is the main cause of producing non-uniform pavement surface and hence lowering down the riding quality. Chip spreader is manufactured locally and is an excellent machine to eliminate delays in spreading aggregate and thus rolling can be done in time before the bitumen gets cold and hence a better degree of compaction of the surface courses can be achieved.

V. CONCLUSION

Following are the concluding remarks regarding the quality check of visually observed FM roads in the Phase I project:

1. Materials used for the construction of embankments are generally of high PI values. They should be borrowed from the specified pit and have the physical properties of a clayey sand with PI values ranges between 4 and 12 percent.
2. Base course materials shall be graded properly and preferable granular materials may be used instead of water bound macadam especially in the water logged areas.

3. In water logged area side slopes of the shoulders on both sides should be 1:3 instead of 1:2.
4. Use of chip spreader as one developed by NTRC or any other make may be made mandatory for the next FM road project.
5. Special attention should be given to the compaction of shoulders.

ANNEX - A

From: Bannu DI Khan Road To: Sarga Khela Khel FMR Code No: 201

Pave.Type	Vehicle	Date	Rater
TST	Toyota Hilux	4-2-92 a.m. (p.m) 12:00	Feroz Abbas

10	Very good
9	
8	
7	Good
(6)	
5	Fair
4	
3	Poor
2	
1	Very poor
0	

Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District : Bannu, NWFP

Fig. 1 Riding Quality Rating Card

From: Jamal Ghani To: Gulab Prasad FMR Code No.

Pave.Type	Vehicle	Date	Rater
TST	Toyota Hilux	3-2-92 a.m. 11:30 p.m.	Fazal Abbas

10	
9	Very good
8	
7	Good
6	
5	Fair
4	
3	Poor
2	
1	Very poor
0	

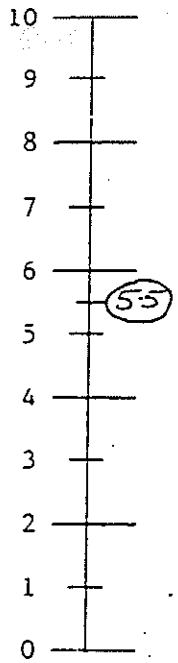
Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District Mardan, NWFP

Fig. 1 Riding Quality Rating Card

From: Dawlat pura To: Sadasar FSR Code No. 2-1-5

Pave.Type	Vehicle	Date	Rater
TST	Toyota Hilux	2-2-92 (a.m) p.m.	Fazl Allah



Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District Peshawar, NWFP

Fig. 1 Riding Quality Rating Card

From: Shaheenabad To: Chak 130/nb FMR Code No. 345

Pave.Type TST	Vehicle Toyota Hilux	Date 9-2-92 (a.m.) p.m.	Rater Fazal Akbar

10	
9	Very good
8	
7	Good
6	
(5)	Fair
4	
3	Poor
2	
1	Very poor
0	

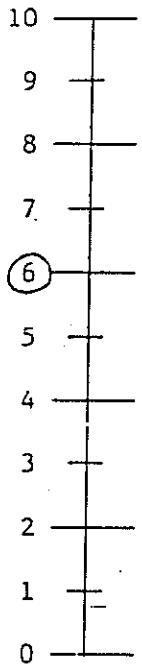
Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District Sargodha, Punjab

Fig. 1 Riding Quality Rating Card

From: Chak Miana To: Lakseem FMR Code No. 343

Pave.Type	Vehicle	Date	Rater
TST	Toyota Hilux	9-2-92 a.m. / p.m.	Feroz Akbar



Very good

Good

Fair

Poor

Very poor

Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District: Sargodha, Punjab

Fig. 1 Riding Quality Rating Card

From: Phullarwana Chowk To: Khangah Dogran FMR Code No. 365

Pave.Type	Vehicle	Date	Rater
TST	Toyota Hilux	8-2-92 a.m. / (p.m.)	Fazl Abbas

10	
9	Very good
8	
7	Good
(6)	
5	Fair
4	
3	Poor
2	
1	Very poor
0	

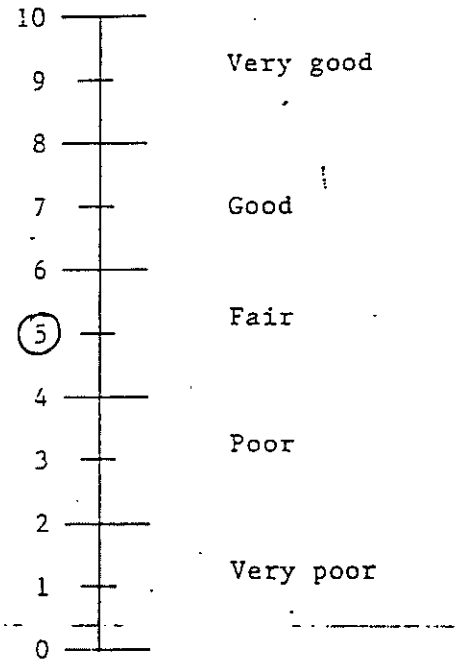
Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District : Sheikhupura, Punjab

Fig. 1 Riding Quality Rating Card

From: Manawala/Addag Lary To: Shahkot Nankana Rd. FMR Code No. 362

Pave.Type	Vehicle	Date	Rater
TST	Toyota Hilux	8-2-92 (a.m.) p.m.	Feroz Akbar



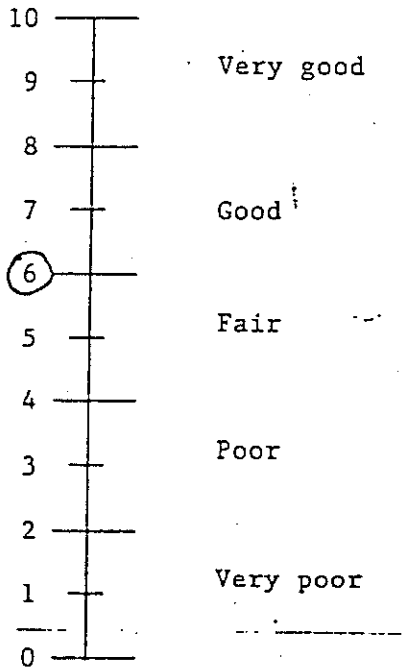
Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District: Sheikhupura, Punjab

Fig. 1 Riding Quality Rating Card

From: Murid wala / Mamun Khanjan To: Chak 200gb FMR Code No. 305

Pave.Type	Vehicle	Date	Rater
TST	Toyota Hilux	16-2-92 (a.m. / p.m.)	Feroz Akbar



Acceptable	—
Yes	✓
No	
Doubtful	

Remarks: District : Faisalabad, Punjab

Fig. 1 Riding Quality Rating Card

From: Usta Mohd To: Mir Wali FMR Code No. 103

Pave.Type	Vehicle	Date	Rater
TST	Toyota Hilux	19-2-92 (a.m.) p.m.	Faiz Alam

10	
9	Very good
8	
7	Good
6	
(5)	Fair
4	
3	Poor
2	
1	Very poor
0	

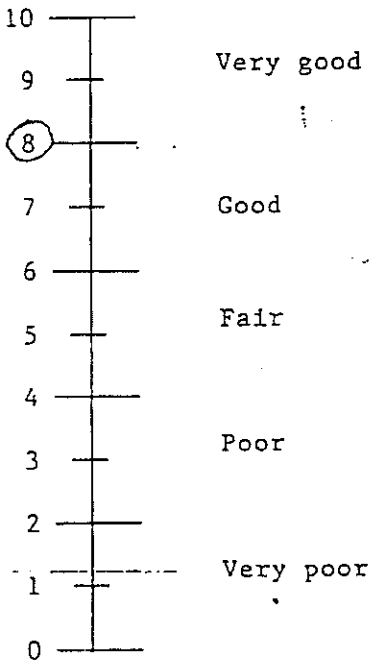
Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District : Nasirabad, Baluchistan

Fig: 1 Riding Quality Rating Card

From: Bangaldero To: Lashari FR Code No. 40502

Pave.Type TST	Vehicle Toyota Hilux	Date 20-2-92 (a.m.) p.m.	Rater Fazl Abbas



Acceptable	
Yes	✓
No	
Doubtful	

Remarks: District: Larkana, Sindh.

Fig. 1 Riding Quality Rating Card