NATIONAL TRANSPORT RESEARCH CENTRE

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UNIT COST OF CONSTRUCTION OF ROADS IN PAKISTAN

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CHAPTER-I

INTRODUCTION

INTRODUCTION:

Road is a most general and basic transportation facility which is indispensable for daily life and for production and marketing activities, in exploiting minerals and forests, in developing new industry and in export and import trade. It also plays an important role in forming comfortable living environment and in providing public space for disaster prevention.

An adequate and efficient highway system is essential for meeting the needs of the present day traffic. It is in fact the corner stone of successful economic and social development. It is, therefore, imperative that ways and means should be focused to meet the requirement, in the shortest possible time.

The main object of well-planned roads in built up areas is to accelerate main Road Traffic to the greatest possible extent consistent with the safety of local traffic, pedestrian or otherwise. This object is best fulfilled by the provision of radial roads and by-passes which prevent thorough traffic and encroaching upon subsidiary roads meant primarily for the use of local resident. It is also imperative, at the same time, to develop sub-arterial roads to facilitate the

safe and speedy movement of transport urban traffic and to link them up with radial roads and by passes if necessary.

A country pays for the roads whether it has them or not. If there are no roads, there is no wheeled transport, when there is no such transport, there is no progress-social or economic. But to build a road is not an end in itself, because it will not serve the purpose unless it is well maintained.

Roads must be well maintained and also be of good quality otherwise the nation would pay heavily for the lack of these fundamental requirements. This is a social service, if roads are not well maintained. This will soon turn from bad to worse eventually resulting in loss of capital sunk in roads, but is also damage to motor vehicles using such roads.

The reasons why road network development suffered in the past was due to the lack of any centralized agency for progressive planning. The other reasons was that road development was not given the due priority it deserved. It was every one's necessity but no body's responsibility. It is, however, chronic human weakness to continue putting off things to the very last and the habit of procrastination is at its worst in the departments run by the Government and certain local authorities. These agencies do not

appear to have a proper appreciation of the inevitable growth, which is bound to take place in the next decade and even earlier which would not allow traffic to wait for new construction or heavy repairs to the existing roads.

The failing of our roads is the cumulative result of many deficiencies, like delayed financial allocations, insufficient field staff, and even ineffective implementation capacity of executing departments besides neglect on maintenance requirement but on account of per-force adoption of low-cost specifications due to lack of funds. We are now paying more for the maintenance of bad roads.

The road length in relation to area is quite low in comparison with other developed and developing countries of the world which is in-sufficient to meet the socio-economic development requirements. At present, there is a deficiency of 346,000 Km. and at the present rate of constructing new roads i.e., roughly 3000 Kilometers per year, it would take years to fulfil the need.

MAIN FUNCTIONS OF A ROAD:

A road performs the following five functions :-

I. An easy approach to land and properties.

II. An easy movement of man and material.

III. An important channel for defence.

IV. It provides long distance and inter-provincial transportation.

V. It opens up backward areas for development.

CLASSIFICATION OF ROADS:

There are more than one criteria by which roads can be classified into various categories. These are :-

(i) Users Criteria;

(ii) Structural Criteria;

(iii) Economic or Cost Criteria.

From the users point of view, roads are generally classified into the following :-

(a) Fair-weather roads.

(b) All-weather roads.

Fair-weather Roads:

This type of road is in vogue from ancient time in this sub-continent and includes village roads and tracks. An important feature of this type is that it is useable only during the dry season. During rainy season, its use is limited because some portions may come under water. Rain may soak and make the surface loose, excessively slippery and the surface may be damaged by traffic. After the rainy season this type of road invariably needs repairs before it can be used.

All-weather Roads

As the name implies, this type of road can withstand heat, cold, rain etc., and is serviceable throughout the year. Its surface can bear the traffic at all times. All-weather roads must have the necessary drainage structures, side drains, smooth and water proof surface.

From the structural point of veiw there are two broad classifications or types i.e, Rigid and Flexible.

Rigid:

The term rigid pavement applies usually to wearing surfaces constructed of portland cement concrete. A pavement constructed of cement concrete is assumed to possess considerable flexural strength which permits it to act as a beam and allows it to bridge over minor irregularities which may occur in the base or sub-grade upon which it rests. Similarly a concrete base which supports a partially rigid wearing surface be regarded as rigid.

Flexible:

All other types of bases and pavements are classified as flexible. The principal elements of the flexible pavement are the wearing surfaces, base and sub-grade. It is assumed that any distortion or displacement of lower layers is eventually reflected

in the wearing surface. Any distortion, occurring in the sub-grade reflects in the base and is transferred to the wearing surface. Hence the term flexible is used to denote the tendency of all layers, in this type of structure, to conform to the shape of the load applied.

From the point of economy or cost, roads may be classified into (i) High Cost Roads and (ii) Low-Cost Roads.

High-Cost Roads:

Roads which can sustain heavy intensity and weight of traffic are called High-Cost Roads.

Low-Cost Roads:

Roads which are designed and constructed to take light traffic are called Low-Cost Roads.

Moreover Roads can be classified on the following basis :-

(A) According to locational and financial responsibility.

(B) According to traffic.

(C) According to Tonnage.

(A) ACCORDING TO LOCATIONAL AND FINANCIAL RESPONSIBILITY:

The roads can be divided into the following classes :-

(a) National Highways.

(b) Provincial Highways.

(c) District Roads - Major.

(d) District Roads - Minor.

(e) Village Roads.

The reason underlying the classification scheme was to distinguish the roads, vis-a-vis, responsibility for their maintenance and development. This classification distinguishes the road by the administrative status of the town it is connected, no matter the roads were metalled or un-metalled.

NATIONAL HIGHWAYS:

The National Highways were inter-provincial roads connecting capitals, ports and international boundries. These National Highways are the responsibility of the Federal Government for their maintenance and development. In consideration of this, it was made a condition that road transport control on the National Highways (90% mileage ran parallel with the railways) would vest in the Centre a camo-flage to safeguard the railways from impending rail-road compertition. Thus, it will not only relieve the provinces of the financial burden but to enable them to develop provincial highways.

PROVINCIAL HIGHWAYS:

The Provincial Highways connected District

Head-quarters and other important towns and linked National Highways, jointly performing the functions of main arteries of trade and commerce. The responsibility of the maintenance and development of the provincial highways is of the provincial government.

DISTRICT ROADS - MAJOR:

District Roads - major and minor are of relative importance, connecting populated areas with each other as also with the Highway - National and Provincial and the rail heads. These roads are designed to take traffic right into the heart of the country and rural population. These roads are the responsibility of the District Boards with or without grants-in-aid from the provinces.

VILLAGE ROADS:

The Third classification scheme had hardly been brought into effect when partition took place and Pakistan became an independent Sovereign State. Pakistan started practically from scratch and had to face many difficulties.

The development of road since independence has not been sufficient to keep the rate of progress in trade and industry and in other spheres of economic activity on national basis, mainly due to meagre share of finance. Therefore, whatever roads were constructed

these were not of standard specification.

The most important point to be considered in connection with the road system is the maintenance bill which the province can afford to pay. Roads can be metalled partly out of development allocation, partly out of revenue. Construction may boom at times of prosperity, but the limiting factor is the repair bill.

The fact is that in the development of roads the government has been facing with serious responsibilities. Although as a whole Pakistan has suitable road construction material, the cost of transport from quarry to road-sites is a very heavy cost item. Absence of water is another difficulty. So the problem has been to discover lasting methods of road construction not prohibitive in first cost. And in spite of the fact that several engineers have been doing all in their powers to make themselves acquainted with the development of road engineering elsewhere and add to their knowledge for the solution of local problems. Yet substantial progress had yet to be achieved while high and increasing maintenance cost continued to retard development. Added to this was the fact that the nature of traffic had been changing rapidly in this country, as elsewhere, owing to great advances in mechanical transport. This necessitated anxious consideration as to the strength and stability of roads and bridges.

(B) ACCORDING TO TRAFFIC:

For an engineer the highway classification will be on the basis of traffic. Even for the user this classification will be convenient. Three factor which are to be considered for classification under this heading are :

1. Traffic Density:

It is the number of vehicles using the road per hour per day. It is represented by a figure e.g. 60 vehicles/hour/day.

2. Character of Traffic:

It means the type of vehicles using that roads. 'M' is used for mixed traffic 'T' represents the trucks or heavy traffic. 'P' represents the passenger traffic.

3. Design Speed:

It is the speed for which the road is designed or is to be designed. It is also represented by figure i.e. 60 KM/H.

Thus an Engineer can classify a Highway as, 1500 M 60, highway which means that a highway have a mixed traffic of 1500 vehicles/day with design speed 60 KM/Hours.

(C) ACCORDING TO TONNAGE:

From Engineering point of view this

classification is useful as structural design can be made on this basis.

It is based on total average weight of vehicles passing over the road per day or per hour whatever the unit is desireable.

Besides, the classification described previously roads can also be classified according to the purpose or shape of the road e.g. :

(a) By-Pass Road:

A road to enable thorough traffic to avoid congested areas or other obstruction to movement.

(b) Service Road:

A subsidiary road constructed between a road and buildings or properties facing thereon and connected only at selected points with the principal road. It may also be the temporary road which is constructed for movement of hauling trucks which are used for hauling construction material to the site of major projects.

(c) Loop Road:

A route formed by a road or series of roads to avoid an obstruction or provide an alternate way of traffic.

(d) Ring Road:

A circumferential road built around an urban area to enable free flow of traffic.

(e) Radial Road:

A road which provides direct communication between centre of an urban area and the other districts.

SCOPE OF STUDY:

(a) To study the crossectional features of various types of road in plain, rolling and mountain topography in the four provinces and special areas and to determine the sectional volume of material of different components.

(b) To identify the quarries for aggregates like sub-base material, base material, surfacing material indicating the haulage district wise.

(c) To recommend on the manufacture and supply of aggregates according to the specification.

(d) To determine haul/load involved for different materials particularly in remote areas.

(e) To determine overall cost in road works, cross drainage, longitudinal drainage, road sign, pavement marking, protection work, if any.

(f) The cost of roads would be worked out including those of culvert and labour component would be determined

in order to establish co-efficients for variations in prices indexing for the purpose of estimation of the project cost at subsequent dates.

CHAPTER-II

METHODOLOGY USED FOR THE STUDY

METHODOLOGY USED FOR THE STUDY:

1. SIZE OF SAMPLE:

The method of data collection was to get the information by personal visits. The Enumerators were asked to visit and extract the information from the relevant records of District Offices of the Provincial Highway Departments. For this purpose, a questionnaire was designed and the enumerators were asked to collect the information from the PC-I forms and detailed Cost estimates maintained by the Drawing section, Final Bills of the Contractors and Measurement Books maintained by the Accounts Section and tender rates submitted by the contractors. All roads completed during 1980-87 were selected. This was done in order to avoid wide variation in the construction and labour charges rates. The information in respect of each road regarding quantities, rates and cost of different items was collected. This survey was carried out in three phases and it covered the entire country.

The total number of proformas filled-in was 487. Out of which 260 proformas were filled in from the Province of Punjab, 118 from Sind, 87 from N.W.F.P. and 22 from Baluchistan. The survey work was carried out in three consecutive phases. In the First Phase 173 proformas were filled-in, in Second Phase 153 and in the Third and last Phase 161.

In the First Phase 44 Districts were covered, out of 74 Districts of Pakistan. In the Second Phase, the information was collected from the Province of Punjab, Sind, NWFP but no information was collected from the Province of Baluchistan. At this stage it was realized that the information collected so far is in-sufficient to present the results of the study in a better way. Thus in order to improve the sample size and to present the study recommendations in a more appropriate manner, the third Phase of the survey was carried out and information was collected from the Provinces of Punjab, Sind, NWFP and Baluchistan.

The every efforts was made by the survey staff from the beginning to collect the required information from the relevant records of the agencies concerned.

2. QUESTIONNAIRE PREPARATION:

The questionnaire is a funnel through which flows all the information from its source to its ultimate use. In this case, only one questionnaire was designed and completed. The forms were printed in sufficient number to cover the entire survey. Like others, this questionnaire has also two parts (a) identification items and (b) questions related with the survey. These questions were grouped together, each one was leading to next. The sequence has been given to the ease of processing. The persons responsible for processing the data were consulted at an early stage of designing

the questionnaire. The quality of the final report and the findings of the survey should not exceed that of the questionnaire.

3. PRE-TESTING OF QUESTIONNAIRE:

Designing an adequate questionnaire is a difficult task. To assure that the questions are properly framed to elicit the desired information, it was proposed that the survey teams should visit the District offices of the Provincial Highway Departments, and to discover whether the requisite information was available in these offices or not. It was confirmed from relevant records that the required information was available in these offices. For this, office of XEN Highway Department Rawalpindi was visited and requisite information collected. On the basis of a careful analysis of the results of the pre-test, the questionnaire was reviewed and revised. The following steps were considered necessary for pre-testing :-

1. It involved the interviewers who carried out the actual survey.
2. The pretest sample was taken as representative of the same overall situation as the one for the study.
3. Close supervision was ensured.
4. It involved more than one interviewers.
5. It was carried out through regular notes and recordings and not depending on memory.
6. It was done much before the actual data collection efforts.

7. The complete questionnaire was tested.

4. ADJUSTING/REVISING THE QUESTIONNAIRE:

The problems identified during the pre-testing were reviewed and necessary adjustments or changes were made in the questionnaire before using it for actual data collection.

5. PREPARATION OF INTERVIEWER'S MANUAL:

The interviewer's manual is a guide for the interviewers which tells them the appropriate manner in which the interview was to be conducted. It was prepared sufficiently ahead of the initiation of the field operation. It covered broadly the following :

I. A brief description of the study, aims and objectives and its importance.

II. Principles of interviewing (its importance, its relation with the project, general attitude of interviewers, rapport building, sequence of questions, respecting interviewers privacy, customs, traditions, draw-backs of probing questions) and be courteous, polite and maintain confidentiality.

III. Question by question objectives, their explanation and other necessary information related to the work of interviewers. In order to achieve good results of the survey a separate manual of instructions was prepared which is given as under:

6. MANUAL OF INSTRUCTIONS FOR FILLING UP THE QUESTIONNAIRE:

The following instructions had been followed while filling up the questionnaire forms for the collection of information regarding the above study :

1. The information regarding 'General information, Geometric, Structural Parameters, Quantities and costs of material used and the labour rates were collected from District Offices of Provincial Highway Departments. All entries were made in chronological order. If required, more than one questionnaire forms were used for recording the information.

   (i) Column-One: Enter the general information.

   (ii) Column-Two: Enter the Geometric parameters.

   (iii) Column-Three: Enter the Structural parameters.

   (iv) Column-Four: Enter the quantities and costs of the items like land acquisition, planning, Design, Earth work, Pavement, Retaining Structures, Drainage Structures, Road Signs, Service roads, Miscellaneous and project costs.

   (v) Column-Five: Enter sources of material and carriage charges.

   (vi) Column-Six: Enter Labour Charges rates.

After having completed the information in respect of all the above columns. Then we have to re-examine and check the entries made in the questionnaire.

It had been noted that while, filling up columns of the questionnaire. Any information considered necessary - in connection with the survey was recorded in last Column. The specimen copy of the filled up questionnaire clearly indicates the type of information as was desired to be recorded in this Column.

The interviewer had to record his name and sign the proforma stating the time, date and full postal address of the 'office visited' where the information had

actually been collected.

7. DATA COLLECTION (FIELD OPERATION):

Human beings always observe and as such questions are raised which need to be answered. The observations made by various individuals generate data. Regardless of the source or methodology used for collecting data, the interviewer in each study has to consider what must exist between observer and the observed and how to establish such relationship.

In this case, the field staff was organised in two groups of one person and they were asked to visit the District Offices of Provincial Highway Departments.

The total number of forms collected from District Offices of Provincial Highway Departments was 487. Out of which 260 proformas were related to Punjab Province and 118 proformas were concerned with Sind, 87 from NWFP and 22 from Baluchistan. The information in respect of all roads completed during 1980-87 had been collected. The total information had been collected in three consecutive phases. The information in respect of roads completed during the above cited period was collected and those having the on-going status during the Ist round of Survey were covered in the IInd and IIIrd phase when they were in complete form.

The field work was completed in a specified time period according to the time schedule. It was highly

desirable that the Enumerator knew the criteria by which and to determine /for whom to collect data. He had to explain the purpose of the survey whenever so desired and indicated that he wished to record a few questions. It was usually found that the majority of officials accepted the brief explanation and answered the questions willingly, but the Enumerators were prepared to answer questions about the survey, if asked. He had to assure the respondent that the information will be confidential.

8. SPECIAL PROBLEMS ENCOUNTERED IN ENUMERATOR:

(a) Listing Error: Since the accuracy of the list has an important bearing on the technical excellence of the survey all such errors were corrected and called to the attention of the officer incharge.

(b) Call Backs: When officer(incharge) was not contacted on the first call at a specific place, the Enumerator left a card of identification there so that the respondent could communicate with the enumerator to arrange for a future meeting and thus it became easy to call the concerned person to get the required information.

(c) Refusal to Cooperate: There was no refusal rate because the information was collected from Government Offices and for the Government.

9. RECORDING OF WRONG ROAD:

Substitution of one road for another was not permissible because it would introduce an unknown biase into the survey.

(B) ADMINISTRATIVE ASPECTS OF THE FIELD ENUMERATION:

I. Payment to Enumerators: The Enumerator were paid full time TA/DA and Taxi Charges as admissible under the rules, depending upon the administrative set up of the survey.

II. Transportation of Enumerators:

Provision of Taxi Charges was made for Enumerators to move from one place to another with a minimum of lost time.

III. Plans for Measuring Performance:

A careful record was kept of the work assigned and completed by each Enumerator. Standard of performance established so that each Enumerator may clearly understand what was expected and required of him.

IV. Control of Progress of Work:

The Supervisory staff had the function of seeing that field work started on time, continued on schedule, and was completed by the end of the enumeration period. At the end of each day the amount of completed work was noted.

10. EDITING OF DATA:

Editing of schedule or filled in proforma consisted of careful inspection to detect any errors and omissions, inconsistencies and/or incompleteness in the data. It also involved and checked on whether data was reasonable, uniform and ready for tabulation. In this case, each schedule was edited twice, once in the field after the day work was over and other at the headquarter. Editing was made in a distinctive colour to avoid confusion between the editor's entries and that of the Enumerator. The routine editing was done in the field office every day after the day work was over. This practice facilitated a contact with the respondents without any delay. Particularly in case when there was a need for the re-visit. The editing, in general, is carried out to ensure the following:

(a) Completeness.

(b) Legibility.

(c) Comprehensiveness.

(d) Consistency.

(e) Uniformity.

(f) Reasons for non-response.

(g) Coding.

11. CODING:

Coding is the assignment of numbers, letters or other symbols to the answers on the questionnaire. The purpose of coding is to classify the answers of all questions into meaningful categories and thus to facilitate the summary of the data. In this case, no proper codes were assigned due to small size of the sample.

12. TABULATION:

After the coding process was completed, there emerged a series of tabulations which constituted the findings of the surveys. For this purpose, a tabulation plan was prepared which provided a system in which various information were sorted, grouped, averaged, rounded, summarized and presented in a way which made the findings most useable, generally speaking, the first tabulations must be in more detail than the tables which ultimately appear in the published report.

The blank tables were prepared to assess the data requirements. They were prepared only to serve as a

guide. It is desirable to circulated them to the eventual data users for suggestions and improvements. After this, a number of tables had been prepared to answer the questions raised at the beginning for which this study was undertaken.

13. ANALYSIS OF DATA:

The objective of the analysis is to answer the basic questions raised at the problem formulation stage. At the analysis stage, the various relationships in terms of cause and effect were seen. The analysis plan is always directed by the objectives of the study. The final report includes the interpretation of the findings of the survey. In writing the analysis, the requirements of all good writings have to be kept in mind, namely, a logical sequence of topics, clear and easily understood exposition of the ideas.

In this case, on the basis of analysis of data, it can be determined that what were the main reasons for making the rates of material more costly whether it is due to design specification, sources and distance and cost of construction material which ultimately makes cost of construction of road high.

CHAPTER-III

PLANNING OF A HIGHWAY

PLANNING OF A HIGHWAY:

The planning stage begins when it is decided to construct a road linking two places. The most appropriate approch is to follow step by step the procedure outlined below:

LOCATION SURVEY:

Location survey helps in deciding the most appropriate alignment because if the route is not suitable it will make the construction costly, difficult and future upgrading and improvement of the road may not be possible. To connect two places, there are generally more than one route available. Each alternative, therefore, has to be examined from the engineering feasibility and cost point of view. For economic feasibility, data regarding population, industry, agriculture, trade etc., are needed. The engineering feasibility involves examination of the topography of the area, river crossings and drainage. This can only be done by obtaining the services of competent engineers. The following points are generally considered while examining the economic justification :

(i) That the road serves as many people as possible.

(ii) It should connect important places like, Post Office, Hospital, Markets etc.

(iii) It should serve agriculture, industry, etc.

(iv) Damages to property and land should be minimum.

To make it technically feasible the route should be such that :-

(i) It follows a level terrain as far as possible so that cutting and filling are less.

(ii) It should not obstruct natural path of drainage, streams and rivers etc.

The highway alignment is the most crucial job in road construction practice. An engineer have to consider a lot of facts which if avoided may cause serious situation, socially, economically and from engineering point of view.

Sometimes the local population wants the alignment to pass through their locality or area for improvement of communication, while at others it may agitate people on the grounds that their valuable agriculture land, grooves, built houses, or other property or assets, would be damaged.

During planning of a highway the length of the road is estimated from the available contoured maps of the localities and cost/km of the construction is estimated from similar maps made elsewhere taking into consideration the terrain of the area. A lump-sum provision is also made for major bridges, minor bridges, river terraining works, culverts, retaining walls,

breast walls and parapet walls.

An overall picture in respect of the possible alignment is made in rather an approximate manner without going out for details. Such an approximate and comparative quick survey of the area is known as reconnaissance survey. The purpose of such a survey is to reduce the number of possible alternate routes to a few ones.

GEOMETRIC STANDARDS:

The geometric standards and specifications include the gradient, curvature, road width, sight distance etc. These Standards and Specifications are different for each category of road and are governed by the traffic needs and ensure an appropriate alignment for the road. These generally take into consideration the future needs so that the investment is not wasted at a later date when traffic warrants improvement or upgrading.

Before dealing with the various type of surveys required for finalization of the alignment, there are certain basic considerations which have to be taken into account in respect of the project as a whole. These factors are described briefly as under :

(i) Straight Route:

Other considerations remain the same, straight route involves the least cost of construction as well as the cost of

maintenance. Apart from this, operational cost of the vehicles will also be reduced.

(ii) Grades and Curves
(iii) Sight Distance } Discussed in Chapter-IV.

(iv) Proper Drainage:

Rain water has a very adverse effect on the pavement as well as the embankment of a highway if suitable provisions for immediate draining of the same are not made.

(v) Availability of Road Building Material:

Stones, Gravels and sand are natural building materials. Their availability along the highway brings down the cost of construction as well as maintenance. During the survey it is noticed that carriage cost of material including loading and unloading charges is the dominating factor as compared to the cost of the material it-self. So the availability of road building material near the proposed highway has great influence on the cost of construction and maintenance.

(vi) Right of Way:

Discussed in the Chapter-IV.

(vii) Height of Embankment:

The height of the road embankment is generally kept from 2' to 3' above the highest flood level of the area.

(viii) Availability of adequate road land:

Before finalizing the route, a planner should be clear that adequate road land is available for road construction all along the route both for safety and future widening purposes. If so then any other route should be considered for that portion where adequate road width is not possible, no matter it costs a bit more.

(ix) Suitable Bridge Site:

Some-times the total cost of the project excluding the erection of a major bridge is less than the cost of construction of an ordinary bridge. So no other single factor has such a decisive influence on the alignment of a highway as the availability of a suitable bridge site. After the final location survey i.e, when the centre line has been marked on the ground cross-sections at right angles to the centre lines at 50 to 100 metre intervals as well as at all sections where

there is change in grade, topography or soil characteristics are taken. On the basis of the survey report or technical report following annexures are to be prepared :

1. Index Plan
2. Site Plan.
3. Longitudinal Sections.
4. Cross-Sections.
5. Details of protective works.
6. Drainage details including culverts and bridges-their length and salient features.
7. Availability of road materials.
8. Design details including traffic considerations.
9. Land Acquisition and compensation schedules.

MATERIALS SURVEY:

The type of soil encountered along various routes under consideration is ascertained. This involves complete investigation in regard to soils through-out the alignment. The type and quality of aggregates, Stones and other materials available locally is also explored. This is done by visiting the area through which the proposed route is to pass.

The identification, classification and use of proper type of soil is an important factor in the planning, design and construction of road projects. The behaviour of the road, to quite an extent, would depend upon the soil type used in the sub-grade as well as in embankment. Experience shows that most of the failures would be avoided if proper care is taken to classify the soil type encountered and design the road. The ordinary soil consists of sand, silt and clay particles.

Soils are generally classified according to the following characteristics :-

(i) Texture.
(ii) Colour.
(iii) Structure.
(iv) Consistency.
(v) Compactness.
(vi) Cementation.
(vii) Chemical Composition.
(viii) Drainage.
(ix) Underground water.

SELECTION OF TYPE OF ROADS:

The next stage is the decision regarding the type of road to be constructed. This would depend upon :-

(i) availability of funds ;
(ii) availability and suitability of local material ;
(iii) anticipated traffic using the road; and

(iv) technical know-how and equipment available.

When traffic anticipated is light and suitable materials like good clay, sand and gravel are available, many alternatives for the type of pavement to be selected are available viz clay, gravel or water bound macadam etc. The comparative cost of each type then helps in arriving at a final decision.

METHOD OF CONSTRUCTION:

Before making the embankment, it is preferrable to build the drainage structures first and then to complete the embankment between successive structures. The general practice is that borrowpits are separated by a piece of land, continuous borrowpit are desirable with proper grades and in the shape of a regular channel to assist in drainage. These should be at some distance from the road. The borrowpits should be on that side of the road from where the natural surface water is flowing to the road, so that natural water is intercepted before reaching the embankment. If the natural surface water flows from both sides of the road, borrowpits should be on both sides. Excavated material should be spread in thin layers and compacted properly.

PREPARATION OF ESTIMATE:

The final stage in planning is the preparation of the estimate in accordance with the specifications and design to be adopted. Great care must be taken to determine the cost on the basis of factual and prevalent rates so that the cost estimate is realistic. Future escalation in cost, if any, may also be indicated, so that the projects are executed without revision, during the construction. Physical phasing depends upon the role of contractor and finance available.

FACTORS EFFECTING UNIT COST OF CONSTRUCTION OF ROADS:

A lot of finance is required for constructing one kilometer of road. It involves expenses on different road components i.e. road work and Road Structures. But there exists some factors which effect the normal unit cost of construction of roads. These factors are discussed below:

1. TOPOGRAPHY:

It is the major and most important factor effecting the cost of construction of roads. Topography of the area in which road is being constructed is the first consideration while estimating and planning of a road. If the area is hilly and mountainous the unit cost of construction of road in that area will be automatically high because it may involve

blasting, excavation, filling and clearing of the site. It will also involve a great number of curves and alignment of the road will depend upon topography of the site and thus it will be difficult for an Engineer or Planner to select the alignment of his own choice. Clearing of heavy boulders from the site is quite a difficult and expensive task in mountainous areas. Retaining walls and Breast walls are also built in hilly areas which involves a heavy amount of finance. A large number of culverts are also built on mountain falls and streams. Heavy machineries for excavation, filling and Hauling trucks for clearing the site will also be involved in mountainous areas. Guard Rails or side blocks are also required for safety purposes. On the other hand, unit cost of construction of roads in plain areas is comparatively low. Preparing of embankment i.e. cutting and filling in plain areas is not a difficult job, even manual labour can do it efficiently. However in agricultural land a large number of culverts are required to be built on major and minor distributories made for the purpose of irrigation. In plain areas an engineer can select an economical and straight route with less

number of curves. Usually no retaining walls and Breast walls are required in plain areas.

2. NATURE OF SOIL:

The Nature of Soil is another important factor which governs the cost of construction of a road. If the soil is hard enough to tolerate traffic load then no sub-base is needed and Base course is directly placed over sub-grade. On the other hand if the soil is weak and loosely packed then sub-base is also needed before the base course is laid. It also effects the thicknesses of sub-base, base course and surfacing. A lot of money is required to increase even one inch of a road component. In some cases soil is stabilized by adding suitable admixture before preparing the sub-grade. Compaction of the sandy soil for the preparation of sub-grade is also very difficult job as compared to clayey soil.

3. AVAILABILITY OF ROAD CONSTRUCTION MATERIAL:

It has been observed that carriage charges for the transportation of construction material from the quarry to the site, costs more than the cost of the material itself. If the material is not locally available then

it has to be borrowed from other places which involves a large amount of transportation charges. So tender rate claimed by the contractor is automatically raised as compared to the area where construction material is locally available.

4. ACCESSIBILITY TO THE SITE:

It also effects the unit cost of construction of roads. If the area where the road is planned to be constructed is very unaccessible, then many problems will develop in order to transport construction material and machinery. For this purpose, service roads, for the maneuvring of the hauling trucks and construction machinery, will have to be constructed before starting the work on the main road. In such cases service Roads costs a lot of finance. If the road is closed for reconditioning, repairing or for widening purposes then the traffic of that road has to be directed. For this purpose, temporary diversion road is constructed. This also costs a lot of money. In this way unit cost of constructing such a road is high as compared to other roads where such requirements are not necessary.

5. AVAILABILITY OF LABOUR:

If the labour is locally available then their rates of working will be low as compared to the area where labour has to be imported from other areas. Road side accommodation will be required for the accommodation of labour. In some places unskilled labour is available but skilled labour has to be imported from other areas. Then the contractor has to pay more than the normal rates. So the tender rates claimed by the contractor will be comparatively more and thus increasing the cost of construction of a road.

6. CLIMATIC CONDITIONS:

Structural design, some-how, depends upon the climatic conditions of the area where the road is planned to be constructed. Rain and snow has a very deteriorating effect on the pavement. On the other hand very dry and hot climate has also an adverse effect on the surface of the pavement as Bitumen melts in hot climate and leaks out of the surface. In both cases separate structural design is made in order to serve the purpose. In this way cost may be more or less varying in different climatic

conditions. Climatic conditions may effect the cost of the road in another way also. That is interference or disturbance during execution of work due to bad climate which reduces efficiency of manual labour and machinery, damage of material and constructed portion during construction process etc.

7. LAND ACQUISITION:

In some cases Government has to acquire land which fall in the alignment of road from the private owners or other government agencies. Government has to pay a hand-some amount of money for this purpose. Agricultural lands are found more expensive than other type of lands. Government has also to pay for compensation for crops standing on that portion of land acquired for the road.

8. TIME OF COMPLETION:

It is observed that a lot of time is utilized for the completion of a road project. During this time prevailing rates become no more valid and revised tender are called to update the rates of the construction materials and labour.

9. STRUCTURAL DESIGN:

Structural design of a highway varies for different road projects. It involves different thicknesses and different material of road components depending upon the availability and requirement of the site. Structural design also depends upon the design speed and traffic volume. A highway designed for a high speed and high traffic volume will cost more than a road designed for low speed and low traffic volume. Type of traffic is also an important factor while designing a highway. A road designed for heavy traffic will cost more than a road designed for light traffic.

CHAPTER-IV

DESIGN CRITERIA OF A HIGHWAY

DESIGN CRITERIA OF A HIGHWAY:

Design of a pavement may involve two types of designs :

1. Geometric Design
2. Structural Design

1. GEOMETRIC DESIGN OF A HIGHWAY:

Corresponding to the various types of roads, standards for various categories of roads in flat, semi-hilly and hilly areas have necessarily to be different. The main considerations for arriving at the various standards are as below:

(a) Adequate width of formation to cater for carriage way, berms and side drains or side walks.

(b) Adequate road land or right of way.

(c) Adequate carriage way to provide the required number of lanes which are based on the frequency and intensity of the traffic.

(d) Sufficient camber to provide a natural drainage to the surface water.

(e) Reasonable gradient which would enable the flow of vehicles at design speed without any appreciable effect on the load carrying capacity.

(f) Suitable design speed with the safety of personnel and goods without increasing loss of transit time.

(g) Adequate sight distance to ensure that the vehicle is brought to rest before collision on obstruction.

(h) Provision of suitable horizantal and vertical curves to avoid discomfort to the passengers whenever there is a change of direction of the highway.

(i) Adequate superelevation and suitable curvature to avoid tilting/toppling of the vehicle and to avoid discomfort to the passengers.

(j) Suitability of Cross-Section.

RIGHT OF WAY:

Right of way means the total width under the control of road authority land is required not only for various components of the highway but also for the future improvement of the same. It is, therefore, customary to acquire sufficient width of the land by either transfer of land from other Government Departments or Local Bodies or by paying compensation to the private owners. The highway department thus gets ownership rights over a strip of land which is known as road land or Right-of-way.

The width of right-of-way should be such that the following elements are accommodated.

(i) FORMATION WIDTH:

The highway is normally in the shape of embankment or cutting. The top width of the embankment or the bottom width of cutting is known as formation width. In case of hilly areas the formation width is taken as the width from the outer end of the parapet wall or retaining wall to the outer surface of the side drain.

(ii) SIDE SLOPES(BOTH IN CUTTING AND EMBANKMENT):

In the case of cutting, the soil is more stable and a side slope of 1:1 to 1:1½ is provided. In the case of embankment, however, a side slope of 1:1½ to 1:2 is normally provided. The depth of cutting or height of embankment is determined from the longitudinal sections and cross-sections of the highway.

(iii) CURVES:

Grades and Curves cause hinderances in respect of the design speed of the vehicles and hence in order to keep the adverse effect of these parameters to the minimum, their extreme limit should be properly defined. Radius curvature of the curve should be greater in order

to avoid serious accidents. Curves may be avoided as far as possible but where unavoidable, these may be smooth and flat, when large curve is provided necessary super elevation must be provided. Parabolic curve is generally used for connecting grade tangents. The horizantal curvatures recommended for various speeds are as follows:

Design Speed M.P.H.	Min. Radius of Curves (Radius in ft.)
30	290
40	520
50	820

In case of curves, the normal visibility of the vehicles coming from opposite directions is restricted due to the effect of the curvature as a result of which additional width of land is required depending upon the angle of the bend or intersection angle.

(iv) Provision for future Widening:

The area opened by the construction of a new road gets develop rapidly. To meet this demand additional road width with improved specifications will be required. If this extra width is not acquired initially, later on acquisition of additional land may involve

much higher compensation cost and other difficulties. Common right-of-ways found in Pakistan are 44 ft - 66 ft-110 ft. etc.

(v) Width of the Pavement:

In deciding the width of pavement, the most important factor is the number of lanes which have to be provided for the carriage way. The pavement width normally adopted for single lane is 12 ft. but it may be as much as 20 ft. If more than two lanes are required, width of lane ways may be computed as = 3n + 0.7 metres

n = Number of lanes.

Classification of Metalled Roads by Width,1985

(000 Kilometers)

Province	Upto 12'	12-24'	24-36'	36-48'	48	(Of which divided)	Total
1	2	3	4	5	6	7	8
Punjab	18.68	6.60	0.94	0.33	0.15	(0.08)	26.70
Sind	7.29	5.07	1.46	1.47	-	-	15.29
NWFP	2.81	1.90	0.22	-	0.03	(0.02)	4.96
Baluchistan	2.53	1.44	0.13	-	-	-	4.10
TOTAL:	31.31	15.01	2.75	1.80	0.15	(0.10)	51.05
%	(61.3)	(29.4)	(5.4)	(3.5)	(0.4)	(0.2)	(100.00)

SOURCE: NTRC Transport Statistics - 1984.

Shoulder:

This is the portion of road between the edge of the road formation and the edge of the pavement. In the case of embankment it is strip between the edge of the pavement and the commencement of down slope.

Camber:

Camber is the convexity provided in the carriage way between the crown and the edge of the pavement. It is also known as cross fall or transverse slope. It is either an eclipse or more often a parabola.

The primary purpose of a camber is to provide surface drainage. The smoother the surface the flater will be the camber. Another factor that influences the camber is the intensity of rainfall. Higher the rate of rainfall in the region, steeper would be the camber.

Camber may be provided by one of the following methods :-

1. Straight line method.
2. Parabola method.
3. Straight at the edges and parabolic at the crown.

Gradient:

The grade is the slope in the longitudinal direction. When the road is ascending then the inclination is said to be positive and when descending it is said to be negative.

If the road ascends or descends one metre for every 40 metres horizontal distance, the gradient is said to be 1 in 40 or 2.5%. Determination of the gradient between two streches of the highway is one of the most important factor in highway design.

The different categories of gradient depends upon the type of terrain such as flat or mountainous and the type of conveyance such as heavy transport vehicles, goods transport, passenger buses, four wheel drive jeeps etc.

The different categories of gradients are given below :

(a) Maximum Gradient.

(b) Minimum Gradient. (1 in 250 for flexible Pavement). 1 in 330 for rigid Pavement.

(c) Average Gradient. (Total rise and Fall/Total Length).

(d) Rolling Gradient

(e) Floating Gradient

In order to determine the maximum gradient which may be permitted in a road, the various resistances which come into play have to be considered.

1. Wind Resistance:

$Ra = C\ AV^2$

A = Projected area of vehicle in m^2

V = Speed in KPH

C = 0.01 constant

Ra = Total air resistance in Kg/m^2

2. Axle Resistance:

For properly designed vehicle it may be neglected.

3. Rolling Resistance:

This varies inversely as the

(i) Diameter of the wheel

(ii) Width of the Tyre.

(iii) Nature of road surface i.e.(Harder surface offers less resistance.

(iv) Grade of the road.

SUPER-ELEVATION:

On curves, there is a tendency for the vehicles to fall away from the outer portion of the curve due to the existence of centrifugal force. To overcome this effect of curvature an inward tilt is provided in the form of transverse inclination, the outer edge being raised with respect to inner edge. It is expressed

as the ratio between the difference of heights of the carriage way. It is also known as CANTT or banking. The advantages of providing super elevation are as under :

(i) Higher speeds without danger of overturning.

(ii) Increased volume of traffic.

(iii) Maintenance is reduced.

(iv) The water can drain off easily

SPEED:

In the present jet age all effort is being made to save time. As a corollary to this, the speed of vehicles is on the increase e.g. an increase in average speed from 50 Km/h to 60 Km/h on a given strech of highway effects a saving of 400 vehicle hours and an increased turn over by approx. 20%.

From the above example, it would be seen that over a specified section of a road the maximum safe speed that can be maintained taking into consideration the design features of the highway should be adhered to.

Thus the maximum safe speed in its turn depends upon the following parameters.

(i) Type of the highway, National, Provincial or District.

(ii) Type of Pavement, rigid or flexible.

(iii) Condition of road surface.

(iv) Nature, Type and intensity of traffic.

(v) Type and Number of Curves.

(vi) Sight Distances.

(vii) Type of Terrain, Rolling, Hilly or Flat.

SIGHT DISTANCES:

Most of the accidents on highways take place because of the inability of the drivers to stop the vehicles well before it may collide with an obstruction. The failure of a driver to stop the vehicle in time may be due to one of the following reasons :

(i) Mechanical Failure specially the brake failure.

(ii) Inadequate sight distance.

(iii) Miscellaneous reasons such as defective eye sight of the driver, short size of a driver, obstruction to vision due to poor visibility.

By sight distance is generally meant the length of the road visible ahead to a driver while driving a vehicle. The sight distance should be kept as liberal as possible and not less than the minimum non-passing sight distance. When sight distance is not long enough to permit over-taking, it is termed as non-passing sight distance. This is very important factor to be considered before finalizing the alignment of the road.

(a) Non Passing Sight Distances or Stopping Sight Distances:

It is the longest distance at which the driver of a moving vehicle is supposed to see 10 cm. or 4 inch high obstacle on the pavement. The ability of a driver to stop the vehicle before striking the obstacle while driving at the design speed depends upon following factors :

(i) Perception Time and Brake Reaction:

It depends upon the alertness of the driver. It is the time interval between the perceiving of the obstruction and applying brakes. It generally does not exceed half a second. The brake reaction time is the time interval which elapses after seeing the obstacle, before brakes are actually applied.

In ordinary cases, the total time of perception and brake reaction may be 3 seconds.

(ii) The Efficiency of Brakes:

It depends upon the condition of road surface, condition of tyres and condition of vehicle itself. The coefficient of resistance (U)

between the tyre and the road surface is usually taken as 0.4.

(b) Passing Sight Distances:

Passing sight distance is defined as the minimum distance open to the view of the driver of a vehicle who is intending to overtake a slower vehicle ahead with safety against the traffic coming from the opposite direction. The different stopping sight distances and passing sight distances for different design speeds are given in the following tables :

S.NO:	Design Speed in Km/h.	Stopping Distance in meters
1.	15	17
2.	30	36
3.	50	67
4.	60	82
5.	80	120
6.	100	156

S.NO:	Design Speed in Km/h.	Overtaking Sight Distance in metres
1.	40	137
2.	48	140
3.	56	243
4.	64	305
5.	80	442

SOURCE: Transportation Engineering (Vol-I) by V.N. Vazirani and S.P. CHANDOLA.

2. STRUCTURAL DESIGN OF PAVEMENT:

The science of pavement design is in its embroynic stage and much difinitive is not known about the effect of axle load on pavement. Primarily, the design of pavement depends upon expected traffic load and load bearing capacity of the soil and is effected by such other factors as environment, climate, type of material used etc. There are several methods of pavement design but the two principal methods most widely used and commonly understood are ones contained in the AASHTO Interim Guide and the British Road Note 29. Before dealing with these methods we must study the various types of pavement and their structural parameters (component).

PAVEMENT:

Pavement is the top layer constructed to provide adequate support for the loads imposed by

traffic. It should produce a firm, stable, smooth and should withstand without damage against the abrasive action of traffic and other deteriorating influences. It is a hard crust placed on the soil formation after the completion of earthwork.

Pavements can be classified into two general types :-

1. Flexible Pavements.
2. Rigid Pavements.

FLEXIBLE PAVEMENTS:

Flexible pavements are those consisting of a base course of suitable granular material with or without bituminous binder, and a bituminous surface course. They have little beam strength and carry the loads by distributing them and reducing their intensity until they may be carried safely on the sub-grade.

Flexible pavement can be divided into two groups, according to the type of base used in the pavement system. These are :

1. Flexible pavement with untreated granular basis.
2. Full-depth asphalt pavement, in which asphalt mixtures are employed for all courses above the sub-grade, in other words, an asphalt base is used in this group.

It is strongly recommended that full-depth asphalt pavements should be used, since untreated

granular bases frequently act as moisture reservoirs which hold water continuously in contact with the sub-grade, causing a gradual decrease in sub-grade strength. In addition, untreated granular bases can not with stand tensile stresses and thus perform in an inferior manner when compared with asphalt bases.

The structure of a flexible pavement generally consists of three significant layers.

Sub-Grade:

It is a term used to describe upper layers of natural soils compacted to serve as foundation for the pavement. The entire road structure rests on the sub-grade and receive traffic load directly from the pavement. The performance of road mainly depends upon the quality of sub-grade. The sub-grade must be strong enough to withstand the traffic load and weather effects. The soil is compacted in layers at optimum moisture content. The upper layers are compacted to 95% modified AASHO, and below 3 ft. depth, the soil is compacted to 85% modified AASHO, because the intensity of stresses is reduced with the depth. For proper surface drainage, the sub-grade top is provided with 2% camber. It involves both cutting and filling of the earth whichever is necessary at the site.

Sub-Base:

It is generally provided between the sub-grade and base course as a gradual change of material in case of weak sub-grade for higher traffic loads. It usually consists of a compacted layers of granular material, either treated or untreated, or of a layer of soil treated with a suitable admixture. In addition to its position in the pavement, it is usually distinguished from the base-course material by less stringent, specification requirement for strength, plasticity, and gradation. The sub-base material should be of better quality than the road bed soil. For reasons of economy, the sub-base is often omitted if road bed soils are of high quality. Three types of materials are used in Pakistan for sub-base depending upon the location, requirement and availability. Generally the construction materials are gravels, crushed stone aggregates and brick ballast. Normally the sub-base is compacted to 95% modified AASHO.

Base-Course:

The base course is the portion of the pavement structure immediately beneath the surface course. It is constructed on the sub-base course, or, if no sub-base is used, directly on the road bed soil. It is placed for proper distribution of traffic loads and providing a suitable surface for surfacing and structural support. It usually consists of aggregates

such as crushed stone, crushed slag, crushed gravel and sand, or combinations of these materials.

It may be used untreated or treated. It is normally compacted to 100% modified AASHO by spreading approximate type and quantity of filler which is normally stone dust.

Surfacing:

The purpose of surfacing is to provide a smooth riding surface and to resist traffic abrasion and water proofing the pavement against the surface water. The most common practice is to apply three coats of bituminous surface treatment consisting of a single size of crushed aggregates or natural Chipping and Bituminous materials.

Rigid Pavement:

Rigid pavement generally consists of a prepared road bed underlying a layer of sub-base and a pavement slab. The sub-base may be stabilised or unstabilised.

Sub-Base:

The sub-base of a rigid pavement structure consists of one or more compacted layers of granular or stabilised material placed between the sub-grade and the rigid slab for the following purposes.

1. To provide uniform, stable and pavement support.

2. To minimize the damaging effects of frost action.

3. To prevent pumping of fine grained soils at joints, tracks, and edges of the rigid slab.

If the road bed soils are of a quality equal to that of a sub-base, no additional sub-base layer is needed. Local experience may also provide useful criteria for the selection of sub-base type.

Pavement Slab:

The basic materials in the pavement slab are Portland cement concrete and Reinforcing Steel. Due to high cost of cement and steel it is very uncommon in Pakistan. Although un-economical it is very smooth, durable and well drained pavement.

CHAPTER-V

DRAINAGE

DRAINAGE:

Description and Purpose:

In the construction and maintenance of any road, drainage is a very important factor. It involves not only the removal of surplus water from the road itself but also includes the prevention of water from reaching the road and the controlled movement of water along and under the pavement. The water involved may be the direct precipitation upon the road itself, the surface run-off from adjacent areas, underground water moving through subterranean channels or strata, or the moisture rising by capillary action from the water table underneath the roadbed.

Surface Drainage:

Surface drainage is considered to be the removal, control and disposal of the water which has been precipitated directly upon the surface of the roadway and immediately adjacent areas. In hilly area this may include water produced by melting of snow.

Pavement Surface:

The pavement should always be as water proof as practicable to prevent the surface water from entering. It should be sufficiently smooth with adequate crown so that water flows to the edges rather than stands in puddles on the surface. If steps are not taken to prevent such action, the water flowing off the pavement

will seep downward at the edge of the pavement to the sub-grade below where it results in sub-grade instability.

Shoulders:

The water on the shoulders, whether falling there directly or running off the pavement should be prevented from causing damage by stabilising shoulders. This can be achieved if the shoulders are constructed of material through which the water may rapidly pass downward and outward without causing damage to the shoulder or seeping into the sub-grade. Densely graded granular material is best for this purpose as it does not become unstable when wet. It is desirable to construct the shoulders with a cross-slope steeper than the crown of the pavement to promote more rapid run-off.

Fore-Slope and Back Slopes:

If the material in the cut slopes or embankment is erodable, the slopes should be protected, wherever feasible, with either a natural or an artificial cover of sod or other vegetation. When conditions are favourable natural revegetation may quickly take place. Slopes composed of rock or other material, not conducive to growth of vegetation, should be covered with a layer of top soil.

Side Ditches:

At the intersection of the cut slope and the shoulder slope a longitudinal ditch should be provided to carry the water flowing down or seeping from the cut slopes or the shoulders. Deep ditches and steep side slopes should be avoided because they are traffic hazard. However, the bottom of the ditch should be at least one foot lower than the sub-grade elevation in order to drain water from the base course under the pavement. To prevent water standing in the ditches the flowline should be smooth and have a slopes of preferably not less then 0.2 percent for paved ditches and 0.5 percent for unpaved ditches. If the ditch is in easily eroded material and on a steep grade, it should be lined with crushed rock, gravel or other locally available erosion resisting materials. In some cases it may be better to construct a series of small check dams.

Outlets to storm sewers, cross drainage pipes, or natural drainage channels should be provided at intervals frequent enough to avoid erosion or exceeding the capacity of the ditch. In general the outlets should be about 500 feet apart for unlined ditches. A suitable drop inlet or headwall should be constructed to permit the water to pass readily from the road ditch to the storm sewer or cross drain pipe below. At the end of a cut, the water from the ditch should not be turned loose. A definite channel should be provided to

take the water to a natural drainage channel or culvert.

Embankment Shoulder Ditches:

If the lateral flow of water across the pavement and shoulders is sufficient to cause erosion of the embankment slopes and it is not feasible to prevent such erosion by vegetation on the slopes, a shallow ditch may be constructed along each shoulder to carry the water to where it can be disposed off in a storm sewer or embankment spillway. The ditch should be at the outside edge of the shoulder so that it will not be a traffic hazard. It may be formed by constructing a low earth levee or it may be paved.

Frequently it will be desirable to construct ditches to divert the water from several drainage channels into one so that only one structure will be required under the road. In doing this, care should be taken to avoid concentrating such a large flow in one channel that might cause severe erosion, depositing sediment and debris on the land beyond culvert outlet. It must be made certain that combined flow will not exceed the capacity of a corresponding structure under an adjacent rail, road or highway.

Underground Drainage:

Underground water may be in motion flowing in well-defined subterranean channels, seeping through-nporous layers between impervious strata, or moving upward by capillarity; or it may be standing in reserviors for lack of an outlet through surrounding impermeable material. In any case, whether close to the surface or at a certain depth, it may cause instability of the road bed or failure of the pavement by saturating and softening the underlying material. In hilly areas it may freeze under the pavement, or it may cause slides by acting as a lubricant on slippage planes. There are three objectives to be attained in underground drainage.

1. Removal of stationery free water in the soil by lowering the water table and providing outlets for water trapped by impermeable materials;

2. Collecting and disposing of water arising in springs under the road or seeping water from the surface of the road; and

3. Intercepting seepage water from outside sources before it reaches the road area.

Types of Underdrains:

Frequently the water tables can be lowered or seepage water intercepted by constructing open drainage ditches draining into a natural surface channel. Such ditches should be as deep as practicable under the circumstances and should have continuous fall to the outlet. For safety and appearance, they should

have gentle side slopes, and should be well-trimmed and rounded. Sometimes the movement of water towards the open ditches may be so slow that underdrains are needed to supplement the ditches. In some cases, open ditches may not be feasible at all and underdrains have to be used entirely especially for intercepting seepage water before it reaches the road and for collecting and disposing of water originating within the roadway limits.

An underdrain usually is a trench in which a line of clay tile, concrete tile, perforated corrugated metal or perforated non-metallic pipe is laid, the trench then being backfilled with porous material.

Sometimes the pipe line is omitted in which case the backfilled trench is called a blind drain or french drain. The type of drain to be used will depend upon the source and the volume of the water to be handled, the availability and cost of the pipe, and the chemical properties of the water and soil.

If the water is coming toward the road from one side only, a single drain on that side to intercept the water before it reaches the road will be sufficient. If the road is in a valley where seepage comes from both sides or if the intent is to lower the water table, drains may be required on both sides of the road. If the water is moving along an impervious layer the trench

should extend an inch or two into this layer. If it is held in a basin by impervious material, the bottom of the trench should be slightly below the bed of the basin. If the removal of free water is desired, the drain should be deep enough to prevent the water rising by capillarity above the desired elevation. Generally the drains should be at least 3 to 4 feet underground and in areas subject to freezing temperatures they should be low enough to hold the water below the depth to which frost will penetrate. When drainage of a large area is required, a system of parallel or herring bone drain will be necessary. The spacing of such drains will depend upon the nature of the soil to be drained, particularly with respect to how far and how rapidly the water will move through it. Several small drains close together will usually be more effective than fewer large drains because the water will not have to travel so far though the natural soil.

Size of Underdrains:

The ordinary range of sizes of pipes for underdrains is 4 inches to 12 inches in diameter, with the 6 inch and 8 inch sizes pre-dominating in usage. Smaller pipe than 4 inch size are generally undesirable because of likelihood of their becoming clogged; pipes larger than 8 inch size are usually unnecessary, except as mains to dispose of the flow from several laterals, because their capacity will exceed the rate of flow

to them through the surrounding soil. For blind drains the minimum width of trench which can be economically constructed in any given soil, will ordinarily afford sufficient capacity.

Pavement and Shoulder Underdrainage:

The sub-grade surface should have a crown of approximately 1/4". If suitable material is available at a reasonable cost, it is desirable that a layer of previous material by placed between the sub-grade and the pavement. This layer of previous material should be at least 3 inches thick and should be composed of sand, gravel or other granular material containing sufficient fines to prevent the inerstices becoming filled with clay, silt or loam. The previous layer should preferably extend the entire width of the embankment or from ditch in cuts. Water seeping down from the road surface will then move by gravity through the previous layer to the outside slopes of the embankment or to the side ditches in cuts.

Cross Drainage Structures:

It is frequently necessary to provide for the passage of water from one side of the road to the other by means of culverts and bridges. Such structures are usually considered as divided into two classes-major and minor. A major structure is defined as one having a total clear opening of more than 20 feet between

endwalls measured along the centerline of the road-way, and including multiple span culverts or trestles if they meet this requirement. A minor structure is any structure having a total clear opening of 20 feet or less.

Type of Structures:

Minor structures may include short bridges but generally are limited to culverts. The practice and method relating to short bridges correspond closely to those for major structures. Culverts may be of the box or arch type constructed of logs, timber, masonry or reinforced concrete or may be pipe culverts of concrete, metal or clay. The type to be used will depend partly upon conditions at the site but primarily the relative cost and availability of the different kinds. If head room is limited, elliptical pipes, segmental arch culverts or low, wide-span bridges or box culverts, will probably be preferable to circular culverts; or multiple installations of small culverts may be better than a single culvert of equivalent cross-sectional area. If the stream carries considerable debris, a single large opening should be used instead of two or more smaller ones.

In general, the flowline of a culvert should conform as nearly as practicable, both vertically and horizontally, to the gradient, elevation and direction of the inlet and outlet channels. Economy and ease of construction will usually require that the culvert

be straight but in special cases broken alignment or a broken gradeline may be desirable to fit the culvert to the natural channel or topography, particularly if any change in the existing conditions might cause damage to adjacent property. The experience has shown that best location for a culvert will normally be at a point of the stream where the span will not be the shortest. But despite this fact it may be the least expensive when consideration is given to the total costs for all items involved, including excavation and backfill, headwalls, endwalls, spilways, inlet and outlet channel changes maintenance, interference with use of the water and possible damage to nearby lands.

If the gradient of the culvert is less than that of the inlet channel, sediment may be deposited at the intake and inside the culvert. This condition together with the decrease in velocity may considerably reduce the capacity. If, however, the gradient is steeper than the outlet channel one of the two conditions will usually result; either destructive erosion of the channel will occur, or sediment will be deposited at the outlet, causing obstruction of the culvert or channel.

Placing the inlet of the culvert higher than the flowline of the intake channel will permit shortening the culvert and also cause sediment and debris to be deposited outside the culvert. If, however, a large amount of sediment and debris is deposited and not removed, the

precautions taken to make certain that the flow through the new channel does not cause damage to adjacent land or interfere with the use or disposal of the water thereon.

The structure opening should be amply large to handle the volume of water without seriously impeding the flow and to permit the passage through it of boulders, logs and debris normally carried by the stream. The required size may be determined by calculating the drainage area, by observing the nature of the runoff, the high and low water marks, and amount of water carried, by comparison with existing structures, and by consulting with residents or others familiar with the local conditions. Even though only a small amount of water is involved, it is essential, in order to provide for cleaning of the culvert, that, except for under-drains, no culvert having a diameter less than 24 inches be installed under the road, and if the length is greater than about 60 feet the minimum diameter should be 36 inches. It is preferable that the minimum diameter be 36 inches for all pipe culverts under the road regardless of their length.

In the determination of the size of culvert opening, consideration should be given to the fact that the normal flow of most streams is often exceeded at the time of rains or floods. It must be decided whether to pay the heavy initial cost and provide a

depression may soon be filled to the level of the culvert and will no longer serve as a settling basin. Furthermore, if road embankment is of a previous material, the water in the inlet basin may seep into the road bed under the culvert and cause instability. On the other hand, if road embankment is impervious and the flow intermittent, there will be a stagnant pool in the inlet basis after each storm. If the culvert intake is below the channel elevation, erosion of the channel may result if it is not paved or in rock. If the outlet is higher than the channel the falling water may cause serious erosion unless it falls upon rock or a paved spillway is provided.

Frequently a shorter length of culvert can be used and a better foundation obtained by shifting the culvert to one side of the original channel or by changing or eliminating the skew. When this is done, care should be taken to change the inlet and outlet channels to conform to the culvert location and direction so that water may enter and leave readily without either by passing the structure or eroding the channels or depositing sediment and debris. If the skew angle is changed, it will usually be preferable to leave the intake end in the original channel and accomplish the change by moving the outlet only. If the outlet is changed, the water should be returned to the original channel as soon as practicable, or necessary

structure adequate for the extreme conditions or to provide a smaller, less costly culvert and suffer the consequences when the abnormal flood water exceeds the capacity of the culvert. The decision will depend upon the circumstances in each individual case.

The natural channel of a stream is usually roughly trapezoidal in shape with the greatest width at the top. For such a stream to enter an arched or circular culvert, its shape must be changed accordingly. This will cause backwater and reduced velocity. At the outlet the reverse change in shape is necessary and serious erosion may result from the increased velocity and eddying action. For this reason, it is desirable to use a culvert large enough so that the top portion will not be needed to handle the water except in extreme cases. This will have the additional advantage of providing space for the passage of floating materials.

The headwall, wings and other appurtenances at the culvert entrance have the following important functions to perform: (i) to retain in their proper position the natural ground and embankment slopes near the entrances : (ii) to prevent the water from undercutting or by passing the structure and from seeping into the roadway: (iii) to cause the transition of the cross section of the stream from the shape of the approach channel to the shape of the culvert: (iv) to provide for entrance of the water into the culvert with

maximum efficiency and (v) to prevent erosion of the approach channel.

Ideal Inlet Structure:

As a rule, the above functions will be best performed if the entrance structure includes the following features :-

(a) Headwall and wings extending high enough above the ground slopes to prevent material from sloughing into the inlet basis. (The slope should intersect the culvert at approximately the inter-section of the top of the culvert and the back of the headwall).

(b) Wings extending well upstream and flared and warped to form the best transition from the approach channel cross section to the culvert cross-section.

(c) An apron extending the full length of the wings with a cut-off wall deep enough to prevent undercutting.

(d) Steeper grade on apron than on the channel bed beyond to increase the velocity of the stream before the more restricted area of the culvert is reached.

(e) Rounded-lip, beveled-edge or flared entrance to the culvert itself.

(f) Intersection of the wings and the headwall face flush with the edges of the culvert.

(g) Face of the headwall perpendicular to the axis of the stream.

Although such construction may be ideal and the most desirable type under critical conditions, it may be impracticable or the cost may be exorbitant in many cases and frequently some other type will serve satisfactorily. An entrance structure conforming to the above requirements, however, will often increase the efficiency of the entrance sufficiently to permit using a smaller culvert opening than would otherwise be required. It may also more than offset the high initial cost by savings in reconstruction and maintenance costs.

For small, low velocity streams with either direct of underfined approach, a straight headwall without wings or apron will be satisfactory and because of low cost and ease of construction will be most desirable.

For the sake of appearance and to properly fit the slopes, it is desirable that the headwall be parallel to the highway tangent regardless of the skew of the culvert. On curves the headwall may be perpendicular to the radius passing through the centre of the end of the culvert. For skewed culverts greater efficiency in the entry of the water and consequently increased of the culvert will be effected if the headwall is

perpendicular to the axis of the stream. For this reason it may be better in special cases to sacrifice appearance to gain efficiency.

Outlet of the culvert is however, different from the inlet. Except perhaps for appearance and simplicity in design and construction there is no reason for the outlet to be the same as the entrance. The natural ground and embankment slopes must be prevented from encroaching on the channel and together with the sides and bottom of the channel, must be protected from erosion. Pipe culverts carrying small or low velocity streams, or having sub-merged outlets, or discharging into rock, paved spillways or other stable material are generally satisfactory without any endwall. If no wall is used the pipe should extend beyond the embankment slope far enough to avoid undercutting or eroding the slope. If the end of the culvert is on filled ground, an endwall structure may be undesirable because settlement of the fill might leave the endwall without support other than the culvert itself.

Usually some type of endwall is needed, especially if an abrupt change in direction of flow is required or if the channel or natural ground has little resistance to erosion. Ordinarily the discharge velocity of the culvert is considerably higher than the normal velocity of the stream. Also the release of the water from the restricted cross section of the culvert to the wider and different

shaped channel beyond causes turbulence and eddies which together with the high velocity may result in serious erosion if not controlled. A straight endwall without wings and apron is useless for this purpose. Wings parallel to the direction of flow are merely a continuation of the culvert sidewalls and so accomplish nothing towards restoring the stream to its natural flow. For best results, the wings should be flared and warped but if the flare angle is too great the eddying action may be increased rather than decreased. Considerable reduction in velocity may be obtained by means of a vertical drop from the culvert floor to the apron especially if a low curb is then constructed across the end of the apron so that a basin is formed. The velocity may also be reduced by making the grade of the apron less steep than that of the culvert. Careful study is necessary to determine the best type of construction to fit the particular condition at each site.

For best appearance and fit the embankment slope and the end wall should be parallel with the centerline of the road regardless of the skew of the culvert and little would be gained by constructing them otherwise except perhaps in special cases.

Depth of Cover Over Culverts:

Culverts should be covered with earth base-course and pavement to the depth which protect them from damage by traffic and fit the alignment grade and cross

section of the highway. For pipe culverts the minimum depth of cover should preferably be at least 3 feet if heavy loads are to pass over them during the construction period or afterward; in any event the minimum depth should be equal to half the diameter of the culvert but not less than one foot.

Debris Control Devices:

Streams frequently carry either floating or rolling along the bottom, considerable quantities of debris ranging from leaves, weeds and small twigs to large tree trunks and boulders. Some provision should be made at or near the culvert entrance to reduce the interference of such debris with the satisfactory operation of the structure. The control device may be a V-shaped barrier of steel, timber of concrete piling or cribbing to deflect large logs and boulders away from the culvert entrance and into basins at the sides. If basins to receive deflected debris are not practicable, a similar barrier may be constructed straight across the channel to catch and hold the debris. For small structures the best barrier will usually be a grating or grillwork of steel or timber constructed directly across the culvert entrance. The spacing of the barrier members should be such that nothing will pass larger than the culvert can handle. The barrier should preferably be high enough to prevent the water and floating debris going over the top even when the water

level is raised because of the obstruction of the lower portion of the barrier by debris, but in many cases such construction will not be feasible.

Foundation Drainage:

It is essential that the foundation under a structure provide support as firm and as nearly uniform as possible under the entire bearing surface. Whenever, conditions permit, the bottom of the excavation should be on solid ground for its full length and width. If it can be avoided culverts should not be placed partly on filled ground and partly on undisturbed ground because of the possibility of unequal settlement which might distort or break the structure. This applies transversely as well as longitudinally and when a sidehill location is used the culvert should be benched into the hillside far enough to be entirely on solid ground. If part of the culvert must be on filled ground, the filled material should be placed in thin layers and thoroughly compacted so that it will provide a foundation as nearly comparable to that afforded by the natural ground as possible.

The installation of drainage structures or systems in embankments should be avoided whenever, practicable because of the possibility of damage to the structure due to partial settlement. This can happen because of the foundation of the structure resting on the soil not firm enough for the purpose. When such an installation must be made, the embankment should be

constructed and thoroughly compacted to a height at least three feet above the elevation of the bottom of the structure. The excavation should then be made in the compacted fill.

Unstable foundation material should be removed and replaced with satisfactory material to the extent practicable. If this cannot be done reasonably, a layer of sand, gravel or other suitable material should be placed on the foundation and worked into the unsatisfactory material until a stable foundation is formed. If a pipe culvert is to be placed in rock excavation, the rock should be removed slightly below the elevation of the bottom of the pipe and a well-compacted cushion of gravel, sand or other suitable material should then be placed as a bed for the pipe.

Installation of Pipe Culverts and Underdrains:

Pipe small enough to handle are usually placed by hand. Some type of tackle or equipment is needed for the larger sizes. Pipes may be lowered into position by means of ropes only. When this method is used the pipe is placed alongside the trench directly above its final position; long ropes are passed under the pipes, one near each end with additional ropes at intermediate points, if needed, of needed. One end of each rope is anchored and the other end is manipulated and played out with

the pipe rolling in until it reaches the bottom of the trench. A trench triped consisting of an A-frame on one side of the trench and a single leg on the other side and equiped with a winch or chain hoist may also be used to lower pipes into places.

Pipes for culverts and underdrains should be carefully placed so that they will be accurately aligned both vertically and horizontally and will rest on a sufficiently firm and uniform bed to prevent or displacement. Bell and spigot pipe should be placed with the bell ends upgrade and with the spigot ends fully entered into adjacent bells. The outside laps of circumferential joints of corrugated metal pipe should point up-grade and the longitudinal haps should be on the sides.

CHAPTER-VI

ANALYSIS OF DATA

ANALYSIS OF DATA:

The existence of good communication is nation's wealth. Road is an important link in the chain of communication and perhaps the oldest channel of communication. The earliest roads may have been the path treaded by men and beasts, for search of food and fuel. The primary purpose for which roads were first developed, was to move surplus goods out and to bring in goods not obtainable locally. Besides trade these routes were also used for invasions by the conquerors and robbers.

Now although there are several means of transportation but roads play an important role in general development of the country as all other types of transportation depends upon the road transport. In this connection a lot of research work have been done and new techniques have been developed in road construction because heavy traffic is increasing day by day. A hand-some amount of finance is always required for construction of roads.

For the purpose of proper project appraisal and cost effectiveness it is desirable to prepare standard unit cost of construction for various types of roads of standard design in various areas of Pakistan. Although the cost of each road section varies according to traffic volume, soil conditions, pavement design and regional factors. It is necessary

to have some standarised unit cost as ready reckoner for overall planning purposes.

The Central Roads Organization, Communication Division prepared a report on "Unit Cost of Road Construction" in May, 1973. Due to price escalation, the cost per Km. as worked out in the report is not valid. It is therefore needed to prepare a report showing Cost/Km. of roads in different areas based on current market rates and update the cost according to changes in rates from time to time.

The information regarding quantities, rates and cost of different road components was collected from District Offices of the Provincial Highway Departments of Four Provinces on a specified questionnaire design for the purpose. The information collected varied from classification of roads to quantities, rates and cost of each component.

A considerable time is involved between the preparation of estimate and completion of a road project thus a lot of difficulty has to be faced in reconciling the road record from the office. Keeping in view the difficulties being faced in getting the information, the districts were selected on sample basis for the Ist-round of survey and the enumerators were sent to each of the selected District to collect information from the offices concerned. This survey was carried out in Three rounds one after

the others.

The total number of proformas filled-in was 487. Out of which 280 proformas were filled in from Punjab, 118 from Sind, 87 from NWFP and 22 from Baluchistan. Out of 74 Districts of Pakistan, 67 were covered during the survey. The number of proformas filled in per District was 8.96% for Punjab, 9.07% for Sind, 6.21% for NWFP and 2.00% for Baluchistan.

During the field survey, the Khanewal District in Punjab was not covered, since it has been carved out recently. In Sind, all the three Districts of Karachi were considered as one District because they have been recently created and no independent office of Highway Department exists in each District. The entire Province of NWFP was covered during the survey. In the Province of Baluchistan, the District of Chagai, Kohlu, Dera Bugti, Kharan, Lasbela and Turbat could not be covered during the survey.

Most common pavement widths observed during the survey were 10, 12, 20 and 24 feet. However, the roads having width of 16 and 18 feet were also seen but they are not very common. The Province-wise common pavement width are given below :

COMMON PAVEMENT WIDTHS IN PAKISTAN

(In Feet)

S.NO:	PROVINCES	PAVEMENT WIDTHS			
1	2	3			
1.	PUNJAB	10	12	20	24
2.	SIND	-	12	20	24
3.	N.W.F.P.	-	12	20	24
4.	BALUCHISTAN	-	12	20	24

It may be seen from the table above that no standard design regarding width of shoulders and layer thicknesses exists. The variation in road components may be due to many reasons like quality of natural soil, traffic volumes, topography and other local and regional factors.

Due to large variations in road components, it is not possible to work out the cost per kilometer of a road in any area and to compare that cost with the cost of another road of the same width in the same area. To over-come such difficulties in the data regarding different road components and to work out the cost per kilometer of road so that it could be compared with the cost per kilometer of another road. The following methodology has been adopted :

For this purpose the roads, were categorised according to pavement widths and standard

pavement sections, were prepared based on the most commonly applied designs which can be seen below :

STANDARD PAVEMENT SECTIONS

S. NO:	Pavement Width (Feet)	Soulder Width (Feet)	Sub-Base (Inches)	Base-Course (Inches)
1	2	3	4	5
1.	10	7	4	4
2.	12	8	6	6
3.	20	10	6	6
4.	24	10	6	6

The cost of road projects can be worked out while considering the following items :

1. Reconnaissance, Survey, Planning, Design and Estimation.
2. Land Acquisition.
3. Earth Work.
4. Sub-Base.
5. Base-Course.
6. Surfacing.
7. Retaining Walls.
8. Culverts.
9. Longitudinal Drainage.
10. Road Signs.
11. Service Roads.

12. Provision for Tool and Plants.

13. Provision for Contingencies and work charged staff.

Earth work, Sub-Base, Base-Course, Surfacing and Culverts are considered as major road components. The Cost/Kilometer is worked out by calculating quantities/kilometer of each of the standard pavement section and multiplying the quantities with the prevailing average rates obtained through the survey results.

Survey, Planning and Estimation:

This is generally carried out by the departments themselves and thus the actual expenditure can not be assessed properly. However, sum of Rs.5000/- is provided for the purpose.

Land Acquisition:

Mostly the roads are being constructed on the existing routes and therefore major portions of land are not needed to be acquired. However for straightening the alignments and removing sharp curves, a small piece of land has to be acquired. A provision of Rs.45,000/- has been made for this purpose.

Retaining Walls/Breast Walls:

Provision of retaining structures depends upon the topography of the area in which road is being built therefore the provision is provided according to the need. For Punjab, Sind, NWFP and Baluchistan the cost of retaining structures has been provided as per survey results. Keeping in view the topography of the region.

(Culverts upto 20 feet span)

The average cost of Culverts per kilometer of road has been worked out on the basis of survey results. The details of cost for Punjab, Sind, NWFP and Baluchistan for standard sections may be seen at Appendix- 2.

Longitudinal Drains:

The survey results has shown that the longitudinal drains are not normally provided in the roads. However their cost has been included wherever these are required.

Road Signs:

A sum of Rs.2500/- have been fixed for Road Signs etc.

Service Roads:

The cost per kilometer for service road has been provided wherever these were encountered during

the survey.

Provision for Tools and Plants:

1% of total costs has been provided for Tools and Plants on all items and about 5% amount has been provided for contingencies and work charge staff excluding cost of land acquisition and tool and plants provision.

As regards the cost of construction per kilometer of 10 feet wide Road in Pakistan is concerned, it has been worked out as Rs.419,234/- for 10 feet wide road which is available in Punjab only, Rs.707,898/- for 12 feet wide road, Rs.998,641/- for 20 feet wide road and for 24 feet wide road is Rs.1,156,678/-. If the cost per kilometer of 10 feet wide road is considered as 100.00. The corresponding cost per kilometer of 12, 20 and 24 feet wide roads will be 169,238 and 276 respectively. It means the cost of construction per kilometer of road increases with the increase in pavement widths. If we take the cost of construction per kilometer of 10 feet wide road as 100.00. The corresponding cost for 12 feet, 20 feet and for 24 feet in Punjab will be 133, 195 and 225 respectively. If the cost of construction per kilometer of 10 feet wide road in Punjab is taken as the standard yard-stick for measuring cost in other provinces then the corresponding cost for Sind for 12 feet, 20 feet and 24 feet will be 186, 256 and 290

respectively. For NWFP is 163, 226 and 258 respectively and for Baluchistan is 192, 275 and 330 respectively. It is observed that the cost of construction per kilometer of road for different pavement widths is highest in Baluchistan and lowest in Punjab. It may be due to the hilly terrain where lot of blasting has to be done to build a road.

INDICES OF CONSTRUCTION COST/KILOMETER OF ROADS IN PAKISTAN

PROVINCE	PAVEMENT WIDTH			
	10 (Feet)	12 (Feet)	20 (Feet)	24 (Feet)
PUNJAB	100	133	195	225
SIND	-	186	256	290
NWFP	-	163	226	258
BALUCHISTAN	-	192	275	330
PAKISTAN	100	169	238	276

NB: 10 feet wide road is available in Punjab only

As stated above, 10 feet wide roads are available in Punjab only. Then there is no comparison of cost per kilometer of 10 feet wide road among other provinces. Moreover, if we consider cost/kilometer of 12, 20 and 24 feet wide roads in Punjab as the standard yard-stick and we take each cost per kilometer as 100.00 then the corresponding costs for Sind with same widths will be 139, 131 and 129 respectively. For NWFP, 122, 116 and 115 respectively

and Baluchistan, 144, 141 and 147 respectively.

INDICES OF CONSTRUCTION COST/KILOMETER OF ROAD IN PAKISTAN

PROVINCE	PAVEMENT WIDTH			
	10 (Feet)	12 (Feet)	20 (Feet)	24 (Feet)
PUNJAB	100	100	100	100
SIND	-	139	131	129
NWFP	-	122	116	115
BALUCHISTAN	-	144	141	147
PAKISTAN	100	127	122	123

NB: 10 feet wide road is available in Punjab only.

The earth work, sub-base, base-course, surfacing and culverts are considered as major road components. The cost of earth work per kilometer of 10 feet wide road is 17.4% of the total cost in Pakistan, for 12 feet wide road is 23.5%, for 20 feet wide road is 20.2% and for 24 feet wide road is 19.1%. Similarly the cost of sub-base per kilometer of 10 feet wide road comes out to be 13.7% of total cost in Pakistan, for 12 feet wide road is 14.1%, for 20 feet wide road is 16.6% and for 24 feet wide is 17.2% road. The cost of base-course per kilometer of 10 feet wide road has been worked out as 17.7% of the total cost in Pakistan, for 12 feet wide road is 17.6%, for 20 feet wide road is 20.1% and for 24 feet wide road is 21.5%. The cost of surfacing per kilometer of 10 feet wide

road has been calculated as 15.1% of the total cost in Pakistan, for 12 feet wide road is 15.9%, for 20 feet wide road is 19.3% and for 24 feet wide road is 20%. The cost of culverts per kilometer of 10 feet wide road has been worked out as 10.8%, for 12 feet wide road is 6.2%, for 20 feet wide road is 6% and for 24 feet wide road is 6%. For remaining items, as independent unit each item has very insignificant cost but their combined cost is about 20% of the total cost/kilometer of road construction.

The cost of construction per kilometer of 10 feet wide road is Rs.419,234/- in Punjab, for 12 feet road is Rs.559,544/-, for 20 feet wide road is Rs.819,299/- for 24 feet wide road is Rs.941,254/-.

The earth-work, sub-base, base-course, surfacing and culverts are considered as major road components. The cost of earth-work per kilometer of 10 feet wide road is 17.4% of the total cost in Punjab, for 12 feet wide road is 14.4%, for 20 feet wide road is 11.9% and for 24 feet wide road is 11.0%. It is observed that the cost of earth-work for 10 feet wide road is higher than for other pavement widths because the cost of earth-work does not increase proportionately with the increase in pavement widths. The cost of sub-base per kilometer of 10 feet wide road comes out to be 13.7% of total cost in Punjab, for 12 feet wide road is 18.5%, for 20 feet wide road is 21%

and for 24 feet wide road is 21.9%. The cost of sub-base per kilometer of 24 feet wide road is higher than for the other pavement widths.

The cost of base-course per kilometer of 10 feet wide road is 17.7% of the total cost in Punjab, for 12 feet wide road is 23.6%, for 20 feet wide road is 26.8% and for 24 feet wide road is 28%. It is evident that the cost of base-course for 24 feet wide road is higher than for other pavement widths.

The cost of surfacing per kilometer of 10 feet wide road is 15.1% of the total cost in Punjab, for 12 feet wide road is 13.6%, for 20 feet wide road is 15.5% and for 24 feet wide road is 16.2%. It means that the cost of surfacing for 24 feet wide road is higher than for other road pavement widths. It is also clear that the cost of sub-base, base-course and surfacing is higher for 24 feet wide road than for other pavement widths but for earth work it is higher for 10 feet wide road.

The cost of culverts per kilometer of 10 feet wide road is 10.8% of the total cost in Punjab, for 12 feet wide road is 9.6%, for 20 feet wide road is 9.0% and for 24 feet wide road is 8.4%. The cost of culverts per kilometer of 10 feet wide road is higher than for other pavement widths. The remaining items are included in others. The cost for which is around 20%

of the total cost.

The cost of earth-work per kilometer of 12 feet wide road is 18.9% of the total cost in Sind, for 20 feet wide road is 16.7% and for 24 feet wide road is 15.6%. It is seen that the cost of earth work per kilometer of 12 feet wide road is higher than for other pavement widths. The cost of sub-base per kilometer of 12 feet wide road is 16.2% of the total cost in Sind, for 20 feet wide road is 19.7% and for 24 feet wide road is 20.8%. It is evident that the cost of sub-base per kilometer of 24 feet wide road is higher than for other pavement widths. The cost of base-course per kilometer of 12 feet wide road is 17.8% of the total cost in Sind, for 20 feet wide road is 21.6% and for 24 feet wide road is 22.8%. The cost of surfacing per kilometer of 12 feet wide road is 11.7% of the total cost in Sind, for 20 feet wide road is 14.2% and for 24 feet wide road is 15%. It is seen that the cost of sub-base, base-course and surfacing per kilometer of road is higher for 24 feet wide road than for other pavement widths but the cost of earth work per kilometer of 12 feet wide road is higher.

The cost of longitudinal drainage per kilometer of 12 feet wide road is 15.7% of the total cost in Sind, for 20 feet wide road is 11.4% and for 24 feet wide road

is 10.1%. It is seen that the cost of longitudianl drainage per kilometer of 12 feet wide road is higher than for other pavement widths.

The cost of Earth-Work per kilometer of 12 feet wide road is 30.7% of the total cost in NWFP, for 20 feet wide road is 26.8% and for 24 feet wide road is 24.9%. The cost of earth work per kilometer of 12 feet wide road is higher than for other pavement widths. The cost of sub-base per kilometer of 12 feet wide road is 9.1% of the total cost in NWFP for 20 feet wide road is 10.9% and for 24 feet wide road is 11.4%. The cost of sub-base per kilometer of 24 feet wide road is higher than for other pavement widths. The cost of base-course per kilometer of 12 feet wide road is 13.4% of the total cost in NWFP, for 20 feet wide road is 16.0% and for 24 feet wide road is 16.9%. The cost of base-course per kilometer of 24 feet wide road is higher as compared to other pavement widths. The cost of surfacing per kilometer of 12 feet wide road is 16.4% of total cost in NWFP, for 20 feet wide road is 22.1% and for 24 feet wide road is 23.2%. The cost of surfacing per kilometer of 24 feet wide road is higher than for other pavement widths. It is evident that the cost of earth work per kilometer of 12 feet wide road is higher whereas the cost of sub-base, base-course and surfacing is higher for 24 feet wide road. The cost of culverts per kilometer of 12 feet wide road

is 6.9% of the total cost in NWFP, for 20 feet wide road is 5.7% and for 24 feet wide road is 6.7%. The cost of culverts is higher for 12 feet wide road as compared to other pavement widths.

The cost of earth work per kilometer of 12 feet wide road is 28.0% of the total cost in Baluchistan, for 20 feet wide road is 23.9% and for 24 feet wide road is 23.2%. The cost of earth work per kilometer of 12 feet wide road is higher than for other pavement widths. The cost of sub-base per kilometer of 12 feet wide road is 13.0% of the total cost in Baluchistan, for 20 feet wide road is 15.2% and for 24 feet wide road is 15.2%. It is seen that the cost of sub-base per kilometer of 20 feet wide road is higher than for other pavement widths. The cost of base-course per kilometer of 12 feet wide road is 16.8% of the total cost in Baluchistan, for 20 feet wide road is 17.2% and for 24 feet wide road is 19.6%. It is seen that the cost of base-course per kilometer of 24 feet wide road is higher as compared to other pavement widths. The cost of surfacing per kilometer of 12 feet wide road is 21% of the total cost in Baluchistan, for 20 feet wide road is 24.5% and for 24 feet wide road is 24.5%. The cost of surfacing per kilometer of 20 feet wide road is slightly higher than for other pavement widths. The cost of culverts per kilometer of 12 feet wide road is 4.2% of the total

cost in Baluchistan, for 20 feet wide road is 5.6% and for 24 feet wide road is 5.3%. The cost of culverts per kilometer of 20 feet wide road is higher than for other pavement widths.

As there is no 10 feet wide road in any province except Punjab. Thus there is no use to make comparison of the same with other provinces. The cost of construction per kilometer of 12 feet wide road is Rs.559,544 in Punjab, Rs.779,827/- in Sind, Rs.683,751/- in NWFP and Rs.808,458/- in Baluchistan. The cost of construction per kilometer of 12 feet wide road is lowest in Punjab and the highest in Baluchistan.

As regards the cost of major components of road construction is concerned, the cost of earth work per kilometer of 12 feet wide road is 14.4% of the total cost in Punjab. 18.9% in Sind, 30.7% in NWFP and 28.0% in Baluchistan. It is evident that the cost of earth work per kilometer of 12 feet wide road is highest in NWFP and lowest in Punjab. The cost of sub-base per kilometer of 12 feet wide road is 18.5% of the total cost in Punjab, 16.2% in Sind, 9.1% in NWFP and 13.0% in Baluchistan. It is apparent that the cost of sub-base per kilometer of 12 feet wide road is highest in Punjab and lowest in NWFP. The cost of base-course per kilometer of 12 feet wide road is 23.6% of the

total cost in Punjab, 17.8% in Sind, 13.4% in NWFP and 16.8% in Baluchistan. It is observed that the cost of base-course per kilometer of 12 feet wide road is highest in Punjab and is lowest in Sind. The cost of surfacing per kilometer of 12 feet wide road is 13.6% of the total cost in Punjab, 11.7% in Sind, 16.4% in NWFP and 21.0% in Baluchistan. It is seen that the cost of surfacing per kilometer of 12 feet wide road is highest in Baluchistan and lowest in Sind. The cost of culverts per kilometer of 12 feet wide road is 9.6% of the total cost in Punjab, 5.1% in Sind, 6.9% in NWFP and 4.2% in Baluchistan. It is observed that the cost of culverts per kilometer is highest in Punjab and lowest in Baluchistan. It may be due to irrigation and drainage system in Punjab. The cost of other road components is about 20% of the total cost in Punjab, 30% in Sind, 24% in NWFP and 17% in Baluchistan.

The cost of construction per kilometer of 20 feet wide road is Rs.819,299/- in Punjab, Rs.1,072,794/- in Sind, Rs.949,313/- in NWFP and Rs.1,153,147/- in Baluchistan. It is evident that the cost of construction per kilometer of 20 feet wide road is highest in Baluchistan and lowest in Punjab.

As regards the cost of major components of road construction is concerned, the cost of earth work per kilometer of 20 feet wide road is 11.9% of the total cost in Punjab, 16.7% in Sind, 26.8% in NWFP and 23.9% in Baluchistan. It is evident that the cost of earth work per kilometer of 20 feet wide road is highest in NWFP and lowest in Punjab. The cost of sub-base per kilometer of 20 feet wide road is 21% of the total cost in Punjab, 19.7% in Sind, 10.9% in NWFP and 15.2% in Baluchistan. It is apparent that the cost of sub-base for 20 feet wide road is highest in Punjab and lowest in NWFP. The cost of base-course per kilometer of 20 feet wide road is 26.8% of the total cost in Punjab, 21.6% in Sind, 16.0% in NWFP and 17.2% in Baluchistan. It is seen that the cost of base-course per kilometer of 20 feet wide road is highest in Punjab and lowest in NWFP. The cost of surfacing per kilometer of 20 feet wide road is 15.5% of the total cost in Punjab, 14.2% in Sind, 22.1% in NWFP and 24.5% in Baluchistan. It is seen that the cost of surfacing per kilometer of 20 feet wide road is highest in Baluchistan and lowest in Sind. The cost of culverts per kilometer of 20 feet wide road is 9.0% of the total cost in Punjab, 4.4% in Sind, 5.7% in NWFP and 5.6% in Baluchistan. It is evident that the cost of culverts per kilometer of 20 feet wide road is highest in Punjab and lowest in Sind. This may be due to irrigation and drainage system in Punjab.

The cost of construction per kilometer of 24 feet wide road is Rs.941,254/- in Punjab, Rs.1,217,363/- in Sind, Rs.1,082,719/- in NWFP and Rs.1,385,360/- in Baluchistan. The earth work, sub-base, base-course, surfacing and culverts are considered as major road components so their cost has been worked out independently. The cost of earth work per kilometer of 24 feet wide road is 11.0% of the total cost in Punjab, 15.6% in Sind, 24.9% in NWFP and 23.2% in Baluchistan. It is seen that the cost of earth work per kilometer of 24 feet wide road is highest in NWFP and lowest in Punjab. The cost of sub-base per kilometer of 24 feet wide road is 21.9% of the toal cost in Punjab, 20.8% in Sind, 11.4% in NWFP and 15.2% in Baluchistan. It is evident that the cost of sub-base per kilometer of 24 feet wide road is highest in Punjab and lowest in NWFP. The cost of base-course per kilometer of 24 feet wide road is 28.0% of the total cost in Punjab, 22.8% in Sind, 16.9% in NWFP and 19.6% in Baluchistan. The cost of base-course per kilometer of 24 feet wide road is highest in Punjab and lowest in NWFP. The cost of surfacing per kilometer of 24 feet wide road is 16.2% of the total cost in Punjab, 15.0% in Sind, 23.2% in NWFP and 24.5% in Baluchistan. It is observed that the cost of surfacing per kilometer of 24 feet wide road is highest in Baluchistan and lowest in Sind. The cost of culverts per kilometer of 24 feet wide road is 8.4% of the total

cost in Punjab, 4.4% in Sind, 6.7% in NWFP and 5.3% in Baluchistan. It is seen that the cost of culverts per kilometer of 24 feet wide road is highest in Punjab and lowest in Sind. This increase in cost of culverts is due to the irrigations and drainage system in Punjab.

While making a comparison of construction cost per kilometer of road having different pavement widths in Punjab, it is observed that the cost of construction per kilometer of road for all pavement widths is lowest in Khushab and highest in Rawalpindi for 10 feet wide road but it is highest for 12, 20 and 24 feet wide road in Bahawalnagar. In Sind, the cost of construction per kilometer of road for all pavement widths is lowest in Thatta. It is highest, for 12 feet wide road in Khairpur but it is highest for 20 and 24 feet wide road in Tharparkar. In NWFP, the cost of construction per kilometer of road for all pavement widths is lowest in Kohistan, it is highest, for all pavement widths, in Karak. In Baluchistan, the cost of construction per kilometer, for all pavement widths of road, is lowest in Sibi and highest in Kachhi. It is pointed out that out of 17 Districts of Baluchistan only 11 Districts have been covered. The data for the remaining 6 Districts was not available at the time of field operation.

A comparison of construction cost per kilometer of road having different pavement widths has been made among the different districts of each province. Realising the importance of major components of road construction, their cost/kilometer has been discussed by district of each province. The major components of road construction are like earth work, sub-base, base course, surfacing and culverts.

In Punjab, the cost of earth work per kilometer 10 feet wide road is highest for Khushab, Rawalpindi, Attock, Sargodha, Leiah and Muzaffargarh. Next to this, it is higher for Jhelum, Gujranwala, Gujrat, Kasur, Faisalabad, Sheikhupura, Bhakkar, Mianwali and Vehari. The lowest cost is for Chakwal, Okara and Bahawalnagar. The cost of sub-base per kilometer of 10 feet wide road is maximum for Okara, Faisalabad, Toba-Tek-Singh, Sahiwal, Vehari, Bahawalpur and Rahim Yar Khan. Next to this, it is larger for Gujranwala, Jhang, Multan, Leiah and Bahawalnagar. It is lowest for Islamabad, Rawalpindi, D.G. Khan, Mianwali and Khushab. The cost of base-course per kilometer of 10 feet wide road is maximum for Okara, Toba-Tek-Singh, Sahiwal, Bahawalpur and Rahim Yar Khan. Next to this, it is larger for Gujranwala, Sheikhupura, Jhang, Bhakkar, Multan and Muzaffargarh. It is lowest for Islamabad, Rawalpindi, Chakwal, Mianwali and D.G. Khan. The cost of surfacing per kilometer of 10 feet wide road is

maximum for Gujranwala, Muzaffargarh, Attock, Kasur, Multan, Sahiwal and Vehari. Next to this it is larger for Toba-Tek-Singh, Sargodha, Bhakkar, Rahim Yar Khan, Gujrat and Jhang. It is lowest for Lahore, Sialkot and Rajanpur. The cost of culverts (upto 20 feet span) per kilometer of 10 feet wide road is maximum for Rawalpindi, Sheikhupura, Chakwal and Mianwali. This may be due to Irrigation and Drainage System available in Punjab. Next to this, it is larger for Jhelum, Sialkot and Bahawalnagar. The cost is lowest for Vehari, Toba-Tek-Singh, Sahiwal, Leiah and Kasur. The cost for remaining items of road construction ranges between 20% to 30% of the totalcost.

The cost of earth work per kilometer of 12 feet wide road is maximum for Khushab, Rawalpindi, Attock, Kasur, Sargodha, Leiah and Muzaffargarh. Next to this, it is larger for Mianwali, Jhelum, Gujranwala, Gujrat, Sheikhupura, Bhakkar and Vehari. It is lowest for Okara, Bahawalnagar and Chakwal. The cost of sub-base per kilometer of 12 feet wide road is highest for Okara, Faisalabad, Toba-Tek-Singh, Multan, Sahiwal, Vehari, Rajanpur, Bahawalnagar, Bahawalpur and Rahim-Yar-Khan. Next to this, it is larger for Gujranwala, Gujrat, Sialkot, Jhang, Leiah and Muzaffargarh. It is lowest for Rawalpindi, Islamabad, and D.G. Khan. The cost of base-course per kilometer

of 12 feet wide road is highest for Okara, Toba-Tek-Singh, Sahiwal, Bahawalnagar, Bahawalpur and Rahim Yar Khan. Next to this, it is larger for Gujranwala, Lahore, Sialkot, Kasur, Gujrat, Sheikhupura, Bhakkar, Multan and Rajanpur. It is lowest for Islamabad and Rawalpindi. The cost of surfacing per kilometer of 12 feet wide road is highest for Gujranwala, Kasur, Sargodha, Multan, Leiah and Muzaffargrah. Next to this it is larger for Khushab, Vehari, Gujrat, Rawalpindi and Islamabad. It is lowest for Sialkot, Lahore and Rajanpur. The cost of culverts (upto 20 feet span) per kilometer of 12 feet wide road is highest for Chakwal, Rawalpindi, Sheikhupura and D.G. Khan. Next to this it is larger for Jhelum and Sialkot. Moreover it is lowest for Gujranwala, Kasur, Sahiwal, Vehari, Toba-Tek-Singh, Bahawalpur and Rahim-Yar-Khan.

The cost of earth work per kilometer of 20 feet wide road is highest for Rawalpindi, Khushab, Sargodha, Mianwali and Attock. Next to this, it is larger for D.G. Khan, Leiah, Muzaffargarh, Bhakkar, Vehari, Gujranwala, Islamabad and Sheikhupura. It is lowest for Okara, Bahawalnagar, Bahawalpur, Rahim-Yar-Khan and Chakwal. The cost of sub-base per kilometer of 20 feet wide road is highest for Faisalabad, Sheikhupura, Okara, Toba-Tek-Singh, Vehari, Sahiwal and Bahawalpur. Next to this, it is larger

for Jhang, Sialkot, Gujranwala, Bahawalnagar, Leiah and Muzaffargrah. The lowest cost is for D.G. Khan, Rawalpindi and Islamabad. The cost of base-course per kilometer of 20 feet wide road is highest for Okara, Toba-Tek-Singh, Sahiwal Bahawalnagar, Bahawalpur and Rahim-Yar-Khan. Next to this, it is larger for Gujranwala, Jhang, Bhakkar, Rajanpur and Muzaffargrah. Moreover, it is lowest for Islamabad and Rawalpindi. The cost of surfacing per kilometer of 20 feet wide road is highest for Attock, Gujranwala, Kasur and Muzaffargarh. Next to this, is larger for Rawalpindi, Islamabad, Khushab, Multan and Leiah. The lowest cost is for Lahore and Rajanpur. The cost of culverts (upto 20 feet span) per kilometer of 20 feet wide road is highest for D.G. Khan, Chakwal, Rawalpindi and Sheikhupura. Next to this, it is larger for Sialkot and Jhelum. The lowest cost is for Gujranwala, Kasur, Vehari, Toba-Tek-Singh, Bahawalpur and Rahim-Yar-Khan.

The cost of earth work per kilometer of 24 feet wide road is highest for Rawalpindi, Attock, Khushab and Mianwali. Next to this, it is larger for Kasur, Muzaffargarh and Leiah. The cost is lowest for Chakwal, Rahim-Yar-Khan and Bahawalpur. The cost of sub-base per kilometer of 24 feet wide road is highest for Faisalabad, Rahim-Yar-Khan, Bahawalpur, Vehari, Sahiwal, Toba-Tek-Singh and Okara. Next to this, it is larger for Gujranwala, Jhang, Multan,

Leiah, Rajanpur, Bahawalnagar and Muzaffargarh. The cost is lowest for Rawalpindi, Islamabad and D.G. Khan. The cost of base-course per kilometer of 24 feet wide road is highest for Okara, Toba-Tek-Singh, Sahiwal, Bahawalnagar, Bahawalpur and Rahim-Yar-Khan. Next to this, it is larger for Vehari, Rajanpur, Bhakkar, Jhang, Sheikhupura, Lahore and Gujranwala. The cost is lowest for Rawalpindi and Islamabad. The cost of surfacing per kilometer of 24 feet wide road is highest for Gujranwala, Attock, Rawalpindi and Islamabad. Next to this, it is larger for Chakwal, Kasur, Khushab, Mianwali and Vehari. The cost is lowest for Bahawalpur, Bahawalnagar, Sheikhupura, Lahore and Sialkot. The cost of culverts (upto 20 feet span) per kilometer of 24 feet wide road is highest for D.G. Khan and Chakwal. Next to this, it is larger for Rawalpindi, Jhelum and Sheikhupura. The cost is lowest for Kasur, Gujranwala, Toba-Tek-Singh, Sahiwal, Vehari and Bahawalpur.

In Sind, the cost of earth work per kilometer of 12 feet wide road is highest for Karachi, Thatta and Sukkur. Next to this, it is larger for Shikarpur and Hyderabad. The cost is lowest for Sanghar, Khairpur and Nawabshah. The cost of sub-base per kilometer of 12 feet wide road is highest for Mirpurkhas, Sanghar and Nawabshah. Next to this, it is larger for Larkana, Jacobabad and Badin. The cost is lowest for Khairpur. The cost of base-course per kilometer of 12 feet wide road is highest for Mirpurkhas and Nawabshah. Next to

this, it is larger for Larkana, Sanghar and Hyderabad. The cost is lowest for Khairpur. The cost of surfacing per kilometer of 12 feet wide road is highest for Dadu, Sanghar and Sukkur. Next to this, the cost is larger for Shikarpur, Jacobabad and Thatta. It is lowest for Khairpur, Mirpurkhas, Hyderabad, Badin and Karachi. The cost of culverts (upto 20 feet span) per kilometer of 12 feet wide road is highest for Badin. Next to this, it is larger for Sukkur and Karachi. The cost is lowest for Khairpur. Mirpurkhas and Sanghar.

The cost of earth work per kilometer of 20 feet wide road is highest for Karachi, Thatta and Sukkur. Next to this, the cost is larger for Shikarpur and Hyderabad. It is lowest for Sanghar and Hyderabad. The cost of sub-base per kilometer of 20 feet wide road is highest for Mirpurkhas, Sanghar and Nawabshah. Next to this, it is higher for Badin, Larkana and Jacobabad. The cost is lowest for Khairpur and Karachi. The cost of base-course per kilometer of 20 feet wide road is highest for Mirpurkhas, Nawābshah, Larkana and Sanghar. Next to this, it is higher for Hyderabad, Jacobabad and Badin. The lowest cost is for Khairpur and Karachi. The cost of surfacing per kilometer of 20 feet wide road is highest for Dadu, Sukkur and Karachi. Next to this, it is higher for Sanghar, Shikarpur and Thatta. The cost of surfacing per kilometer of 20 feet wide road is lowest for Badin, Mirpurkhas and Hyderabad. The cost of culverts per

kilometer of 20 feet wide road is not very significant and ranges between 3% to 8% of the total cost.

The cost of earth work per kilometer of 24 feet wide road is highest for Karachi, Thatta and Sukkur. Next to this, it is higher for Shikarpur, Hyderabad, and Larkana. The cost is lowest for Mirpurkhas and Nawabshah. The cost of sub-base per kilometer of 24 feet wide road is highest for Mirpurkhas. Next to this, it is larger for Sanghar, Larkana, and Nawabshah. The cost is lowest for Khairpur and Karachi. The cost of base-course per kilometer of 24 feet wide road is highest for Mirpurkhas and Nawabshah. Next to this, it is larger for Larkana, Hyderabad and Sanghar. The cost is lowest for Khairpur. The cost of surfacing per kilometer of 24 feet wide road is highest for Dadu, Sukkur and Sanghar. Next to this, it is larger for Jacobabad and Badin. The cost is lowest for Mirpurkhas, Hyderabad and Badin. The cost of culverts (upto 20 feet span) per kilometer of 24 feet wide road is not significant. It ranges between 3% to 7% of the total cost.

In NWFP, the cost of earth work per kilometer of 12 feet wide road is highest for Peshawar, Mardan and Dir. Next to this, it is larger for Karak, Manshera and Swat. The cost is lowest for Chitral. The cost of sub-base per kilometer of 12 feet wide road is highest for FATA, D.I. Khan and Chitral. Next to this, it is larger for Mardan, Bannu and Manshera.

The cost is lowest for Karak and Malakand. The cost of base-course per kilometer of 12 feet wide road is highest for Mardan, Bannu and Dir. Next to this, it is larger for D.I. Khan, Abbottabad and Manshera. The cost is lowest for Chitral, Karak and Malakand. The cost of surfacing per kilometer of road is highest for Chitral and FATA. Next to this, it is larger for Bannu, Abbottabad, Manshera and D.I. Khan. The cost is lowest for Mardan. The cost of culverts (upto 20 feet span) per kilometer of 12 feet wide road is highest for Mardan, Swat and Karak. Next to this, it is larger for Peshawar, Bannu and Malakand. The cost is lowest for Dir and Manshera.

The cost of earth work per kilometer of 20 feet wide road is highest for Peshawar, Manshera and Dir. Next to this, it is larger for Karak, Swat and Mardan. The cost is lowest for Chitral. The cost of sub-base per kilometer of 20 feet wide road is highest for FATA. Next to this, it is higher for Chitral, Manshera, D.I. Khan and Bannu. The cost is lowest for Karak. The cost of base-course per kilometer of 20 feet wide road is highest for Bannu and Dir. Next to this, it is larger for Mardan, D.I. Khan, Abbottabad and Manshera. The cost is lowest for Chitral and Karak. The cost of surfacing per kilometer of 20 feet wide road is highest for Chitral and FATA. Next to this, it is larger for Bannu, Abbottabad, Manshera and Mardan.

The cost is lowest for Malakand. The cost of culverts (upto 20 feet span) per kilometer of 20 feet wide road is highest for Karak and Swat. Next to this, it is larger for Malakand, D.I.Khan and Bannu. The cost is lowest for Mansehra and Dir.

The cost of earth-work per kilometer of 24 feet wide road is highest for Peshawar, Mansehra and Dir. Next to this, it is larger for Swat, Karak and Mardan. The cost is lowest for Chitral and FATA. The cost of sub-base per kilometer of 24 feet wide road is highest for FATA and Chitral. Next to this, it is larger for D.I. Khan, Bannu, Kohat and Mansehra. The cost is lowest for Karak, Malakand, Swat and Peshawar. The cost of base-course per kilometer of 24 feet wide road is highest for Dir and Bannu. Next to this, it is larger for Mardan, D.I. Khan, Abbottabad. The cost is lowest for Karak and Malakand. The cost is highest for Chitral. Next to this, it is larger for FATA, Bannu, Mansehra and Abbottabad. The cost is lowest for Malakand. The cost of culverts(upto 20 feet span) per kilometer of 24 feet wide road is highest for Karak and Swat. Next to this, it is larger for Malakand, D.I. Khan and Bannu. The cost is lowest for Dir, Mansehra and Mardan.

In Baluchistan, 11 Districts out of 17 Districts have been covered during the survey. The data for remaining 6 Districts was not available. The cost of earth work per kilometer of 12 feet wide road is highest for Panjgur and Kachhi. Next to this, it is larger for Kalat, Gawadar and Loralai. The cost is lowest for Pishin and Khuzdar. The cost of sub-base per kilometer of 12 feet wide road is highest for Khuzdar. Next to this, it is larger for Kalat, Gawadar, Loralai and Sibi. The cost is lowest for Punjgur and Kachhi. The cost of base-course per kilometer of 12 feet wide road is highest for Khuzdar. Next to this, it is larger for Kalat and Nasirabad. The cost is lowest for Pishin and Quetta. The cost of surfacing per kilometer of 12 feet wide road is highest for Quetta, Loralai, Sibi and Nasirabad. Next to this, it is larger for Gawadar, Kachhi and Zhob. The cost is lowest for Punjgur and Pishin respectively. The cost of culverts (upto 20 feet span) per kilometer of 12 feet wide road is highest for Zhob. Next to this, it is larger for Pishin. The cost is negligible for remaining Districts covered during the survey.

The cost of earth work per kilometer of 20 feet wide road is highest for Punjgur and Kachhi. Next to this, it is larger for Gawadar, Kalat and Loralai. The cost is lowest for Pishin, Zhob and

Khuzdar. The cost of sub-base per kilometer of 20 feet wide road is highest for Khuzdar. Next to this, it is larger for Kalat, Sibi, Loralai and Gawadar. The cost is lowest for Kachhi. The cost of base-course per kilometer of 20 feet wide road is highest for Khuzdar. Next to this, it is larger for Nasirabad, Kalat and Kachhi. The cost is lowest for Quetta and Pishin. The cost of surfacing per kilometer of 20 feet wide road is highest for Loralai, Sibi, Quetta and Nasirabad. Next to this, it is larger for Gawadar, Kachhi and Kalat. The cost is lowest for Pishin and Punjgur. The cost of culverts(upto 20 feet span) per kilometer of 20 feet wide road is highest for Zhob. Next to this, it is larger for Pishin. The cost is insignificant for the remaining districts of Baluchistan.

The cost of earth work per kilometer of 24 feet wide road is highest for Punjgur and Pishin. Next to this, it is larger for Gwadar, Kalat and Loralai. The cost is lowest for Zhob and Pishin. The cost of sub-base per kilometer of 24 feet wide road is highest for Khuzdar. Next to this, the cost is higher for Sibi, Loralai and Gawadar. The cost is lowest for Punjgur and Kachhi. The cost of base-course per kilometer of 24 feet wide road is highest for Khuzdar, Kachhi and Nasirabad. Next to this it is larger for Kalat, Gawadar and Loralai. The cost is lowest for Quetta and Pishin. The cost of surfacing per kilometer of 24 feet wide road is highest for Quetta. Next to this, the cost

is higher for Loralai, Nasirabad and Sibi. The cost is lowest for Pishin and Punjgur. The cost of culverts (upto 20 feet span) per kilometer of 24 feet wide road is highest for Zhob. Next to this, the cost is larger for Pishin. The cost is insignificant for the remaining Districts of Baluchistan covered during the survey, it ranges between 2% to 3% of the total cost.

While comparing the cost per kilometer of roads of different pavement widths in Punjab, attempt has been made to work out the cost of major road components of each district. The cost of earth work per kilometer of 10 and 12 feet wide road is highest for Khushab and lowest for Bahawalnagar and Okara respectively. Where-as the cost of earth-work per kilometer of 20 and 24 feet wide road is highest for Rawalpindi and lowest in Okara. The cost of sub-base per kilometer of 10 and 24 feet wide road is highest for Rahim-Yar-Khan. The cost of sub-base per kilometer of 10 and 24 feet wide road is lowest in Rawalpindi and D.G. Khan respectively. The cost of sub-base per kilometer of 12 and 20 feet wide road is highest in Faisalabad and Sheikhupura respectively, whereas it is lowest in Rawalpindi. The cost of base-course per kilometer of road(for all pavement widths) is highest in Balawalpur and lowest in Islamabad. The cost of surfacing per kilometer of 10, 12 and 20 feet wide road is highest in Gujranwala

and lowest in Lahore, whereas for 24 feet wide road it is highest in Attock and lowest in Lahore. The cost of culverts per kilometer of road (for all pavement widths) is highest in Mianwali, Chakwal and D.G. Khan respectively. Whereas it is lowest (for all pavement widths) in Vehari.

In Sind, the cost of earth work per kilometer of 12 and 20 feet wide road is highest in Thatta and lowest in Sanghar whereas for 24 feet wide road it is highest in Karachi and lowest in Sanghar. The cost of sub-base and base-course (for all pavement widths) is highest in Mirpurkhas and lowest in Khairpur. The cost of surfacing per kilometer of 12 feet wide road is highest for Dadu and lowest for Khairpur. The cost of surfacing per kilometer of 20 feet wide road is highest for Karachi and lowest for Mirpurkhas whereas the cost per kilometer of 24 feet wide road is highest in Dadu and lowest in Mirpurkhas. The cost of culverts (for all pavement widths) is highest in Badin and lowest in Khairpur. This may be due to different routes of indus river in District Badin.

In NWFP, the cost of earth work per kilometer for (all pavement widths) is highest in Peshawar and lowest in Chitral. The cost of sub-base per kilometer of road (for all pavement widths) is highest in FATA and lowest in Karak. The cost of base-course per kilometer of 12, 20 and 24 feet wide road is highest

in Mardan, Bannu and Dir, whereas for all pavement widths it is lowest in Chitral. The cost of surfacing for all pavement widths is highest in Chitral but for 12 feet wide road it is lowest in Mardan and for 20 and 24 feet wide road it is lowest in Malakand. The cost per kilometer of road (for all pavement widths) of culverts is highest in Karak and for 12 feet wide road it is lowest in Dir and for 20 and 24 feet wide road it is lowest in Manshera.

In Baluchistan, the cost of earth work per kilometer of 12 and 20 feet wide road is highest in Panjgur and lowest in Pishin but for 24 feet wide road it is highest in Kachhi and lowest in Zhob. The cost of sub-base per kilometer (for all pavement widths) is highest in Khuzdar and lowest in Punjgur. The cost of base-course per kilometer(for all pavement widths) is highest in Khuzdar and lowest in Quetta. The cost of surfacing per kilometer (for all pavement widths) is highest in Quetta but it is lowest (for 12 feet wide road) in Punjgur and for 20 and 24 feet wide road it is lowest in Pishin. The cost of culverts per kilometer (for all pavement widths) is highest in Zhob and lowest in Nasirabad.

CHAPTER-VII

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS AND RECOMMENDATION:

At the time of independence, in Pakistan condition of roads was not too good as they had been subjected to heavy use for troops and other movements and repairs had been neglected during the war years. Some roads had broken up and were in danger of disappearing. There was urgent need not only for building more roads but also for saving the old ones by repairing and improving their conditions, and addition was directed in both these directions.

The reasons why road network development suffered in the past was due to the lack of any centralized agency for progressive planning. The other reason was that road development was not given the due priority it deserved. It was every one's necessity but no body's responsibility. It is, however, a chronic human weakness to continue putting off things to the very last and the habit of procrastination is at its worst in the departments run by the Government and certain local authorities. These agencies do not appear to have a proper appreciation of the inevitable growth, which is bound to take place in the next decade and even earlier which would not allow traffic to wait for new construction or heavy repairs to the existing roads.

The failing of our roads is the cumulative result of many deficiencies, like delayed financial allocations, insufficient field staff, and even ineffective implementation capacity of executing departments besides neglect on maintenance requirement but on account of per-force adoption of low cost specifications due to lack of funds. We are now paying more for the maintenance of bad roads.

The average annual increase in metalled roads was less than 500 kilometers upto 1969-70, 1500 kilometers a year during 1969-70 to 1979-80 and is now about 2000 kilometers a year. Thus Pakistan being a developing country poorly supplied with roads, has made considerable efforts for the development of roads in the country.

The kilometerage of roads presently existing in our country is too meagre to meet the socio-economic development requirements. At present, there is a deficiency of 346,000 Km. and at the present rate of constructing new roads i.e. roughly 3,000 kilometers per year it would take years to fulfill the need.

An adequate and efficient highway system is essential for meeting the needs of the present day traffic. It is in fact the corner stone of successful economic and social development. It is, therefore, imperative that ways and means should be focused to meet the requirement in the shortest possible time.

The total number of proformas filledin during the survey was 487. Out of which 280 proformas were filledin from the Province of Punjab, 118 from Sind, 87 from NWFP and 22 from Baluchistan. Out of 74 Districts of Pakistan, 67 were covered during the survey, because the data for the remaining Districts was not available at the time of survey.

The survey was carried out in three consecutive phases. In the First Phase 173 proformas were filledin, in the Second Phase 153 and in the Third Phase 161. In the First Phase 44 Districts were covered throughout the country. In the Second Phase the information was collected from the Province of Punjab, Sind and NWFP but no information was collected from the Province of Baluchistan. At this stage it was realized that the information collected so far is in-sufficient to present the results of study in a better way. Thus in order to improve the sample size and to present the study recommendations in a more appropriate manner. The Third Phase of survey was under-taken and the information collected was related to all the Province of the country.

As regards the cost of construction per kilometer of 10 feet wide road in Pakistan is concerned, it has been worked out as Rs.419,234/- for 10 feet wide road which is available in Punjab only, Rs.707,898/- for 12 feet wide road and Rs.998,641/-

for 20 feet wide road and Rs.1,156,678/- for 24 feet wide road. It is observed that the cost of construction per kilometer of road increases with the increase in pavement widths.

If the cost of construction per kilometer of 10 feet wide road is considered as 100. The corresponding cost for per kilometer for 12, 20 and 24 feet wide road in Punjab will be 133, 195 and 225 respectively. If the cost per kilometer of 10 feet wide road in Punjab is taken as standard yard-stick for measuring cost for other province then the corresponding cost for Sind for 12, 20 and 24 feet wide road would be 186, 256 and 290 respectively. For NWFP is 163, 226 and 258 respectively and for Baluchistan is 142, 275 and 330 respectively. It is observed that the cost of construction per kilometer of road for different pavement widths is highest in Baluchistan and lowest in Punjab. It may be due to the hilly terrain where lot of blasting has to be done to build a road.

The cost of construction per kilometer of 10 feet wide road is Rs.419,234/- in Punjab, for 12 feet wide road is Rs.559,544/-, for 20 feet wide road is Rs.819,299/- and for 24 feet wide road is Rs.941,254/-.

In Punjab, it is observed that the cost of sub-base, base-course and surfacing is higher for 24 feet wide road than for other pavement widths but

the cost of earth work is higher for 10 feet wide road. The cost of culverts per kilometer of 10 feet wide road is higher than for other pavement widths. The cost of remaining items is around 20% of the total cost.

The cost of construction per kilometer of 12 feet wide road is Rs.779,827/- in Sind, for 20 feet wide road is Rs.1,072,794 and for 24 feet wide road is Rs.1,217,363/-.

It is seen that the cost of sub-base, base-course and surfacing per kilometer of road is higher for 24 feet wide road than for other pavement widths but the cost of earth work per kilometer of 12 feet wide road is higher.

The cost of construction per kilometer of 12 feet wide road is Rs.683,751/- in NWFP, for 20 feet wide road is Rs.949,313/- and for 24 feet wide road is Rs.1,082,719/-. It is evident that the cost of earth work per kilometer of 12 feet wide road is higher than for other pavement widths whereas the cost of sub-base, base-course and surfacing is higher for 24 feet wide road.

The cost of culverts per kilometer of 12 feet wide road is higher as compared to other pavement widths.

The cost of construction per kilometer of 12 feet wide road is Rs.808,458/- in Baluchistan, for 20 feet wide road is Rs.1,153,147/- and for 24 feet

wide road is Rs.1,385,360/-.

It is seen that the cost of earth work per kilometer of 12 feet wide road is higher than for other pavement widths but for sub-base it is for 20 feet wide road. In case of base-course it is higher for 24 feet wide road. For surfacing, it is again higher for 20 feet wide road.

As there is no 10 feet wide road in any province except Punjab. Thus there is no use to make comparison of the same with other provinces. The cost of construction per kilometer of 12 feet wide road is Rs.559,544/- in Punjab, Rs.779,827/- in Sind, Rs.683,751/- in NWFP and Rs.808,458/- in Baluchistan. The cost of construction per kilometer of 12 feet wide road is lowest in Punjab and the highest in Baluchistan.

As regards the cost of major components of road construction is concerned, the cost of earth work per kilometer of 12 feet wide road is highest in NWFP and lowest in Punjab. However, the cost of sub-base is highest in Punjab and lowest in NWFP. Moreover, the cost of base-course is highest in Punjab and lowest in Sind. It is also seen that the cost of surfacing is highest in Baluchistan and lowest in Sind and for culverts the cost is highest in Punjab and lowest in Baluchistan. It may be due to irrigation and drainage system in Punjab. The

cost of other road components is about 20% of the total cost in Punjab, 30% in Sind, 24% in NWFP and 17% in Baluchistan.

The cost of construction per kilometer of 20 feet wide road is Rs.819,299/- in Punjab, Rs.1,072,794/- in Sind, Rs.949,313/- in NWFP and Rs.1,153,147/- in Baluchistan. It is evident that the cost of construction per kilometer of 20 feet wide road is highest in Baluchistan and lowest in Punjab.

As regards, the cost of major components of road construction is concerned, it has been worked out as a percentage of the total for each province. The cost of earth work per kilometer of 20 feet wide road is highest in NWFP and lowest in Punjab. The cost of sub-base is highest in Punjab and lowest in NWFP and for base-course it is highest in Punjab and lowest in NWFP. Moreover, the cost of surfacing is highest in Baluchistan and lowest in Sind and for culverts, it is highest in Punjab and lowest in Sind.

The cost of construction per kilometer of 24 feet wide road is Rs.941,254/- in Punjab, Rs.1,217,363/- in Sind, Rs.1,082,719/- in NWFP and Rs.1,385,360/- in Baluchistan.

The earth-work, sub-base, base-course, surfacing and culverts are considered as major road components

so their cost has been worked out as a percentage of total cost for each province. It is seen that the cost of earth work per kilometer of 24 feet wide road is highest in NWFP and lowest in Punjab and the cost of sub-base is highest in Punjab and lowest in NWFP. However, the cost of base-course is highest in Punjab and lowest in NWFP. For surfacing, it is highest in Baluchistan and lowest in Sind and the cost of culverts is highest in Punjab and lowest in Sind. This increase in cost of culverts is due to the irrigations and drainage system in Punjab.

While comparing the cost per kilometer of roads of different pavement widths in Punjab, attempt has been made to work out the cost of major road components for each districts. The cost of earth work per kilometer for 10 and 12 feet wide road is highest for Khushab and lowest for Bahawalnagar and Okara respectively. Whereas the cost of earth-work per kilometer of 20 and 24 feet wide road is highest for Rawalpindi and lowest for Okara. The cost of sub-base per kilometer of 10 and 24 feet road is highest for Rahim-Yar-Khan and is lowest for Rawalpindi and D.G. Khan respectively. The cost of sub-base per kilometer of 12 and 20 feet wide road is highest in Faisalabad and Sheikhupura respectively and is lowest in Rawalpindi. The cost of base-course per kilometer of road(for all pavement widths) is highest in Bahawalpur and lowest in Islamabad. The cost of

surfacing per kilometer of 10, 12 and 20 feet wide road is highest in Gujranwala and lowest in Lahore whereas for 24 feet wide road, it is highest in Attock and lowest in Lahore. The cost of culverts per kilometer of road (for all pavement widths) is highest in Mianwali, Chakwal and D.G. Khan respectively whereas it is lowest in Vehari.

In Sind, the cost of earth work per kilometer of 12 and 20 feet wide road is highest in Thatta and lowest in Sanghar whereas for 24 feet wide road it is highest in Karachi and lowest in Sanghar. The cost of sub-base and base-course (for all pavement widths) is highest in Mirpurkhas and lowest in Khairpur. The cost of surfacing per kilometer of 12 feet wide road is highest for Dadu and lowest for Khairpur. The cost of surfacing per kilometer of 20 feet wide road is highest for Karachi and lowest for Mirpurkhas whereas for 24 feet wide road, it is highest in Dadu and lowest in Mirpurkhas. The cost of culverts (for all pavement widths) is highest in Badin and lowest in Khairpur. This may be due to different routes of indus river in lower Sind.

In NWFP, the cost of earth work per kilometer for (all pavement widths) is highest in Peshawar and lowest in Chitral and the cost of sub-base is highest in FATA and lowest in Karak. The cost of base-course per kilometer of 12, 20 and 24 feet wide

road is highest in Mardan, Bannu and Dir whereas it is lowest in Chitral. The cost of surfacing (for all pavement widths) is highest in Chitral but for 12 feet wide road it is lowest in Mardan and for 20 and 24 feet wide road it is lowest in Malakand. The cost per kilometer of road (for all pavement widths) of culverts is highest in Karak and for 10 feet wide road it is lowest in Dir and for 20 and 24 feet wide road it is lowest in Manshera.

In Baluchistan, the cost of earth work per kilometer of 12 and 20 feet wide road is highest in Panjgur and lowest in Pishin but for 24 feet wide road it is highest in Kachhi and lowest in Zhob. The cost of sub-base per kilometer (for all pavement widths) is highest in Khuzdar and lowest in Punjgur. The cost of base-course per kilometer (for all pavement widths) is highest in Khuzdar and lowest in Quetta. The cost of surfacing per kilometer (for all pavement widths) is highest in Quetta but it is lowest (for 12 feet wide road) in Punjgur and for 20 and 24 feet wide road it is lowest in Pishin. The cost of culverts per kilometer (for all pavement widths) is highest in Zhob and lowest in Nasirabad.

CONCLUDING REMARKS:

1. In Punjab, the cost of construction per kilometer of 10, 12, 20 and 24 feet wide road is Rs.419,234/-, Rs.559,544/-, Rs.819,299/- and Rs.941,254/- respectively. 10 feet wide road is available in Punjab only. In Sind, the cost of construction per kilometer of 12, 20 and 24 feet wide road is Rs.779,827/-, Rs.1,072,794/- and Rs.1,217,363/- respectively. The corresponding cost per kilometer for NWFP is Rs.683,751/-, Rs.949,313/- and Rs.1,082,719/- and for Baluchistan is Rs.808,458/-, Rs.1,153,147/- and Rs.1,385,360/- respectively. It is apparent that the cost of construction per kilometer of road (for all pavement widths) is highest in Baluchistan and lowest in Punjab. It is also observed that the cost of construction per kilometer of road increases with the increase in pavement widths.

2. In Punjab, the cost of construction for sub-base, base-course and surfacing is higher for 24 feet wide road than for other pavement widths but the cost of earth work is higher for 10 feet wide road. It is also evident that the cost of culverts per kilometer of road is higher for 10 feet wide road than for other pavement widths. In Sind and NWFP, the cost of earth-work per kilometer of 12 feet wide road is

higher than for other pavement widths whereas the cost of sub-base, base-course and surfacing is higher for 24 feet wide road. In Baluchistan, the cost of earth work per kilometer of 12 feet wide road is higher than for other pavement widths but for sub-base, and surfacing it is higher for 20 feet wide road and for base-course it is higher for 24 feet wide road.

3. The cost of earth-work per kilometer of 12 feet wide road is highest in NWFP and lowest in Punjab. The cost of sub-base and base-course is highest in Punjab and lowest in Sind whereas the cost of surfacing is highest in Baluchistan and lowest in Sind but the cost of culverts is highest in Punjab and lowest in Sind. This may be due to irrigation and drainage system in Punjab. The cost of earth work per kilometer of 20 feet wide road is highest in NWFP and lowest in Punjab. For sub-base and base-course, it is the reverse. The cost of surfacing is highest in Baluchistan and lowest in Sind. The cost of earth work per kilometer of 24 feet wide road is highest in NWFP and lowest in

Punjab but in case of sub-base it is reverse. The cost of base-course is highest in Punjab and lowest in NWFP, but for surfacing, it is highest in Baluchistan and lowest in Sind.

4. In Punjab, the cost of construction per kilometer of road (for all pavement widths) is lowest in Khushab but for 10 feet wide road it is highest in Rawalpindi and for 12, 20 and 24 feet wide road it is highest in Bahawalnagar. In Sind, the cost of construction per kilometer of road (for all pavement widths) is lowest in Thatta. For 12 feet wide road it is highest in Khairpur and for 20 feet and 24 feet wide road it is highest in Tharparkar. In NWFP, the cost of construction per kilometer of road (for all pavement widths) is lowest in Kohistan and highest in Karak. In Baluchistan, the cost of construction per kilometer of road (for all pavement widths) is lowest in Sibi and highest in Kachhi.

RECOMMENDATIONS:

1. Detailed information regarding costs, rates, queantities and sources of road construction materials alongwith carriage charges and labour rates should be collected. This can be done if different surveys are conducted and regular programmes are instituted requiring different agencies to provide information on regular basis.

2. Roads should be constructed under certain standard specifications in order to meet the future traffic requirements.

3. Rates of carriage charges for road construction material should be minimized by providing subsidy to the railways and other agencies involved in the activity. This will reduce cost of construction/ kilometer of road.

4. To facilitate accelerated pace of road net-work development, the road construction machinery should be exempted from custom duty and sales tax especially for public sector/under developed areas.

5. Resource constraints need to be removed at all levels to overcome the existing deficiency and future road net-work development.

6. Such studies should be conducted on regular basis at least at an interval of five years in order to determine the latest cost of construction/kilometer of roads, which will help the planners and policy makers to plan road construction activities in more appropriate manner.

STANDARD QUESTIONNAIRE FOR
" UNIT COST OF CONSTRUCTION FOR ROADS "

UNIT COST OF CONSTRUCTION FOR ROADS:

A. GENERAL INFORMATION:

Name of Project _____

_____

Province _____ District _____

Length of Road _____ Km

Estimate Date _____

Commencement Date _____

Completion Date _____

Completion Time: Estimated _____ Months. Actual _____ Months

Classification:

- ☐ National
- ☐ Provincial
- ☐ Municipal
- ☐ District
- ☐ Other _____

Sponsored by:

- ☐ Federal Govt.
- ☐ Provincial Govt.
- ☐ Other _____

Survey by:

- ☐ Govt. Deptt.
- ☐ Local Consultants
- ☐ Foreign Consultants.
- ☐ Other _____

Cost Estimation by:

- ☐ Govt. Deptt.
- ☐ Local Consultants.
- ☐ Foreign Consultants.
- ☐ Other _____

Construction by:

- ☐ Govt. Deptt.
- ☐ Local Contractors.
- ☐ Foreign Contractors.
- ☐ Other _____

Supervision by:

- ☐ Govt. Deptt.
- ☐ Local Consultants.
- ☐ Foreign Consultants.
- ☐ Other _____

Expenditure Phasing:

(Rupees)

Expenditure	1st	2nd	3rd	4th	5th	6th	7th	Total
Estimated								
Actual								

B. *GEOMETRIC PARAMETERS:*

Item	Design	Actual
Four lane divided	☐	☐
Four lane undivided	☐	☐
Two lane	☐	☐
Single lane	☐	☐
Katcha	☐	☐
Shingle	☐	☐

Pavement Type:

☐ Rigid ☐ Flexible ☐ Other_____

Wearing Surface:

☐ Carpet ☐ Surface Treatment

☐ Other_____

Terrain:

☐ Flat _____Km ☐ Rolling_____Km

☐ Hilly_____Km ☐ Other _____Km

Soil Condition:

☐ Sandy_____Km ☐ Silty _____Km

☐ Rocky_____Km ☐ Clayey_____Lm

☐ Other_____

Roadway Widths:

(Meters)

Item	Right of Way	Formation	Carriage Way	Shoulders
Estimated				
Actual				

C. STRUCTURAL PARAMETERS:

Pavement Thickness:

(Centimeter)

Item	Sub-Grade	Sub-Base	Base	Surfacing
Estimated				
Actual				

Materials Used:

Item	Sub-Grade	Sube-Base	Base	Surfacing
Estimated				
Actual				

D. QUANTITIES AND COSTS:

1. Land Acquisition:

Item		Unit	Ownership		Total
			Govt.	Private	
Area	Estimated				
	Actual				
Unit Cost	Estimated				
	Actual				
Cost	Estimated				
	Actual				

2. Planning and Design:

Item	Cost (Rs.)			Total (Rs.)
	Planning	Designing	Estimation	
Estimated				
Actual				

3. Earth Work:

Item	Quantities		Costs (Rs.)		
	Unit	Amount	Unit	Unit Cost	Amount
Estimated					
Actual					

4. Pavement:

	Item	Quantities		Cost (Rs.)		
		Unit	Amount	Unit	Unit Cost	Amount
Sub-Base	Estimated					
	Actual					
Base	Estimated					
	Actual					
Surfacing	Estimated					
	Actual					
Total	Estimated					
	Actual					

5. Retaining Structures:

Item	Cost (Rs.)	
	Estimated	Actual
Retaining walls		
Breast walls		
Other		
Total		

6. Drainage Structures:

a) Cross Drainage:

Item		Culvert Span				Total
		0'-5'	6'-10'	11'-15'	16'-20'	
Nos.	Estimated					
	Actual					
Unit Cost	Estimated					
	Actual					
Cost	Estimated					
	Actual					

b) Longitudinal Drainage:

Item	Quantities		Cost (Rs.)			Total
	Unit	Amount	Unit	Unit Cost	Amount	
Estimated						
Actual						

7. Road Signs:

	Item	Number	Unit Cost (Rs.)	Total Cost (Rs.
Estimated	Mile/Km Stones			
	Boundary Pillars			
	Guide Signs			
	Pvavement Marking			
	Other			
	Total			
Actual	Mile/Km Stones			
	Boundary Pillars			
	Guide Signs			
	Pavement Marking			
	Other			
	Total			

8. Service Roads:

Item	Costs (Rs.)	
	Estimated	Actual
Service Roads		
Diversions		
Total		

9. Miscellaneous:

Item	Costs (Rs.)	
	Estimated	Actual
i) Premium		
ii) Contingencies		
iii) _____		
iv) _____		
v) _____		

10. Project Costs:

Item	Costs (Rs.)
Total Estimated	
Total Completion	

SOURCE OF MATERIALS AND CARRIAGE CHARGES:

Material	Sources	Distance (Km)	Carriage Charges	
			Unit	Cost
i) Earth				
ii) Crush				
iii) Gravel				
iv) Bitumen				
v) Bricks				
vi) Sand				
vii) Steel				
viii) Cement				
ix)				
x)				

LABOUR RATES

Activity	Unit	ESTIMATED		ACTUAL	
		Machine Operating Cost	Labour Cost	Machine Operating Cost	Labour Cost
Sub-Grade Preparation					
Sub-Base Preparation					
Base Course Preparation					
Surfacing					
Cross Drainage					
Longitudinal Drainage					
Landscaping					
Other					

Note:- Machine Operating Cost mean, cost to complete that unit of activity i/c fuel, depreciation, Wear/Tear etc.

LIST OF DIAGRAMS

FIG.1

AVERAGE CONSTRUCTION COST / KILOMETER OF ROAD IN PAKISTAN

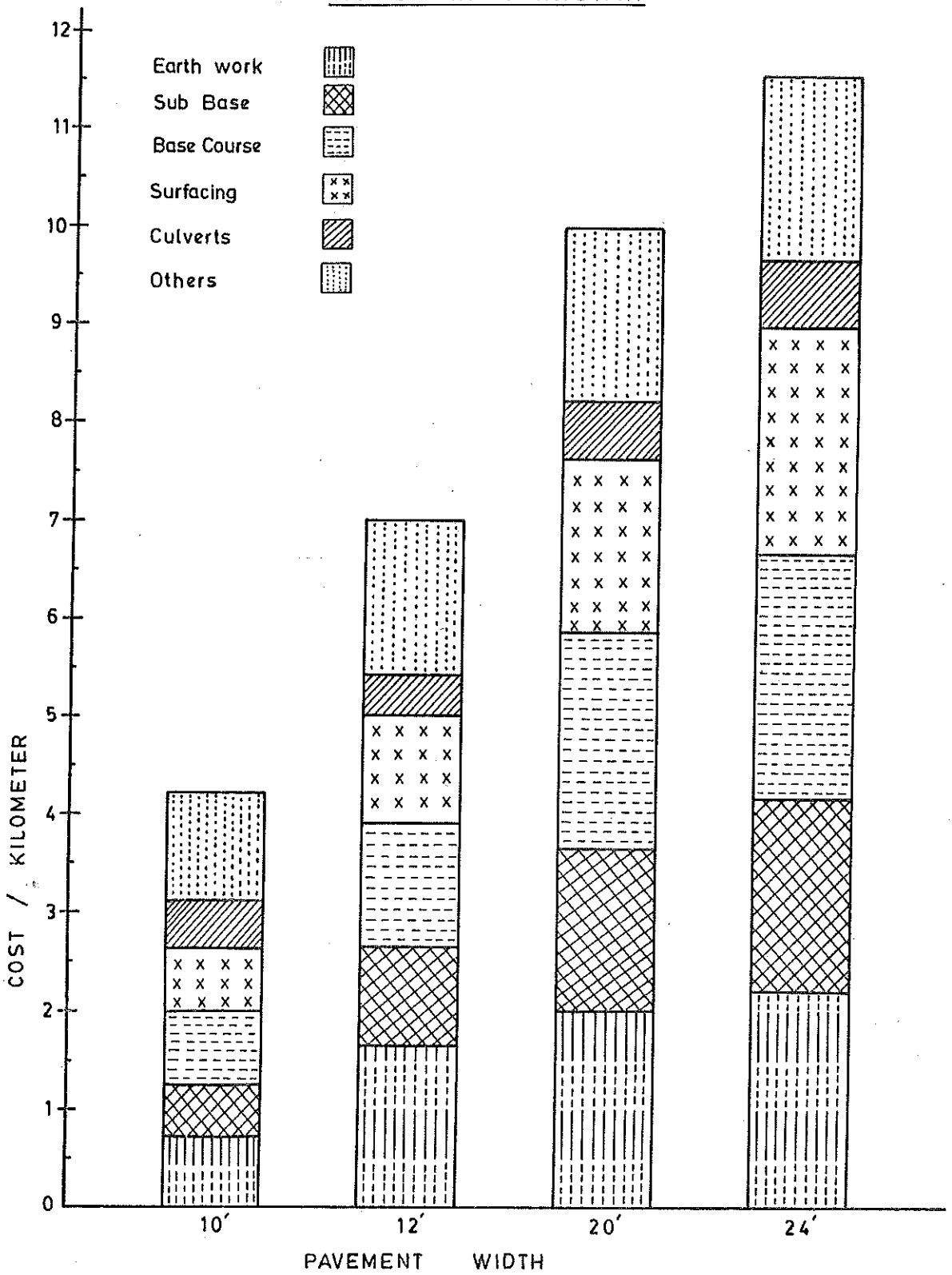


FIG.2

AVERAGE CONSTRUCTION COST / KILOMETER OF ROAD IN PUNJAB

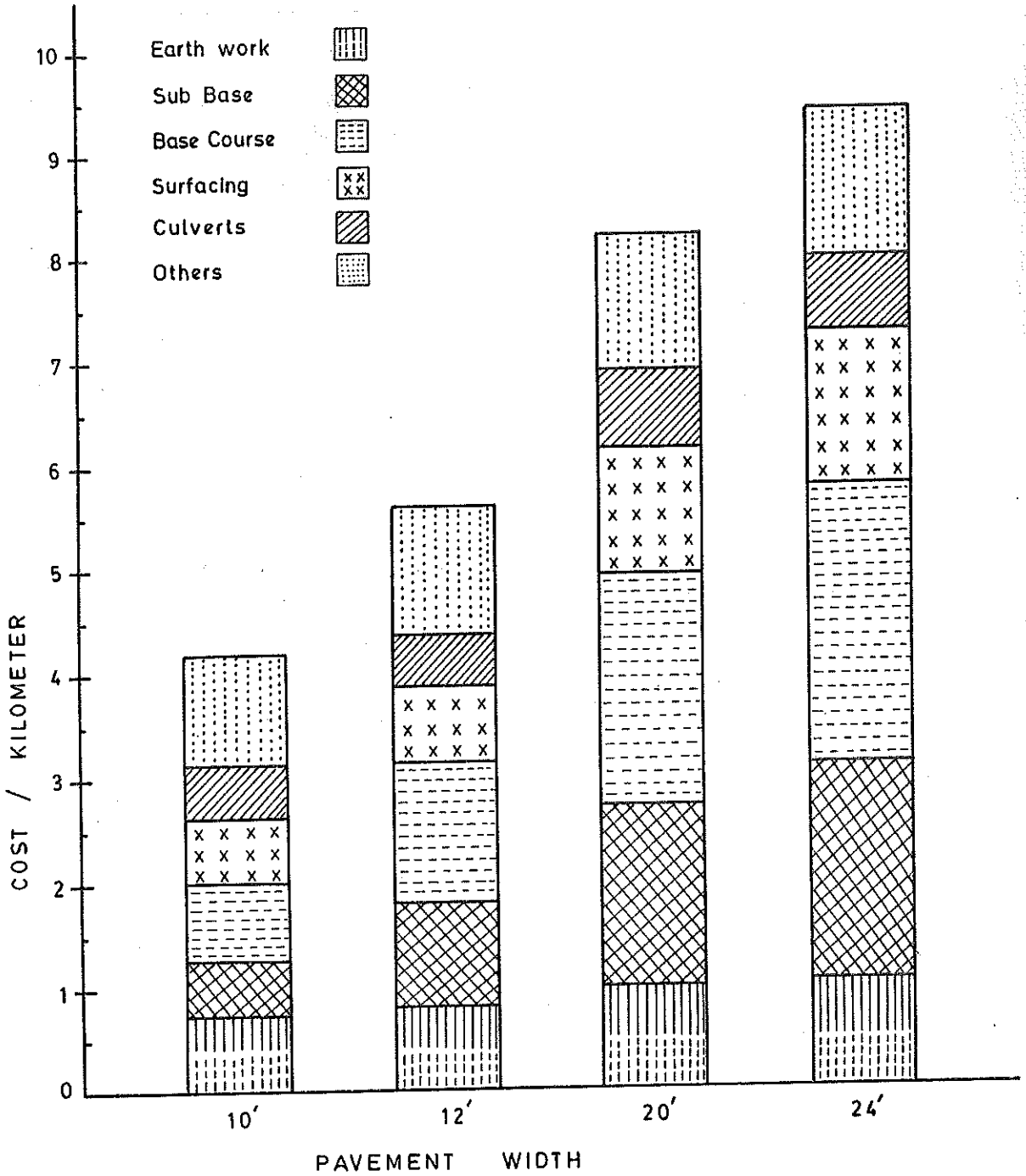


FIG.3

AVERAGE CONSTRUCTION COST / KILOMETER OF ROAD IN SIND

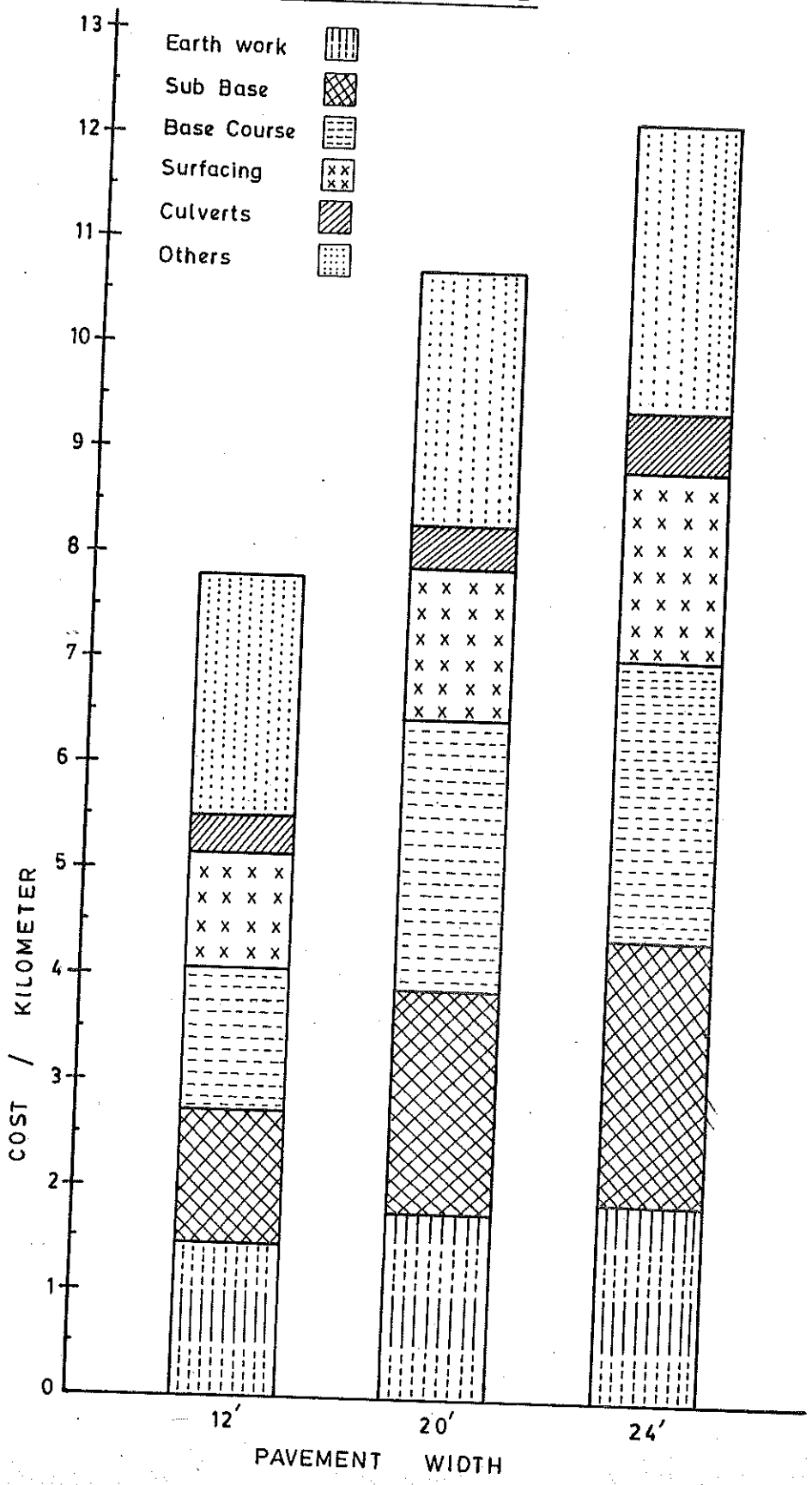


FIG.4 AVERAGE CONSTRUCTION COST KILOMETER OF ROAD IN N.W.F.P.

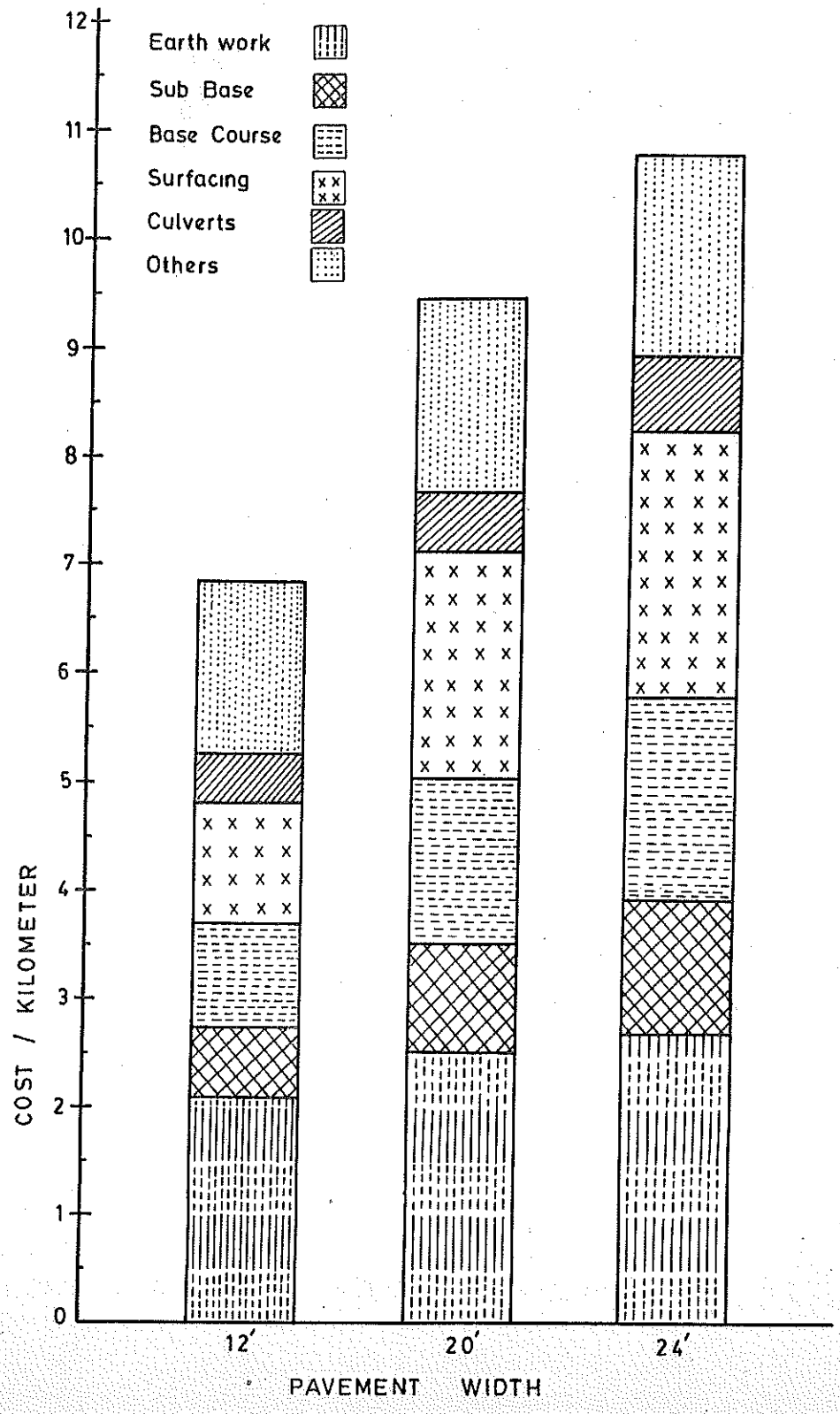
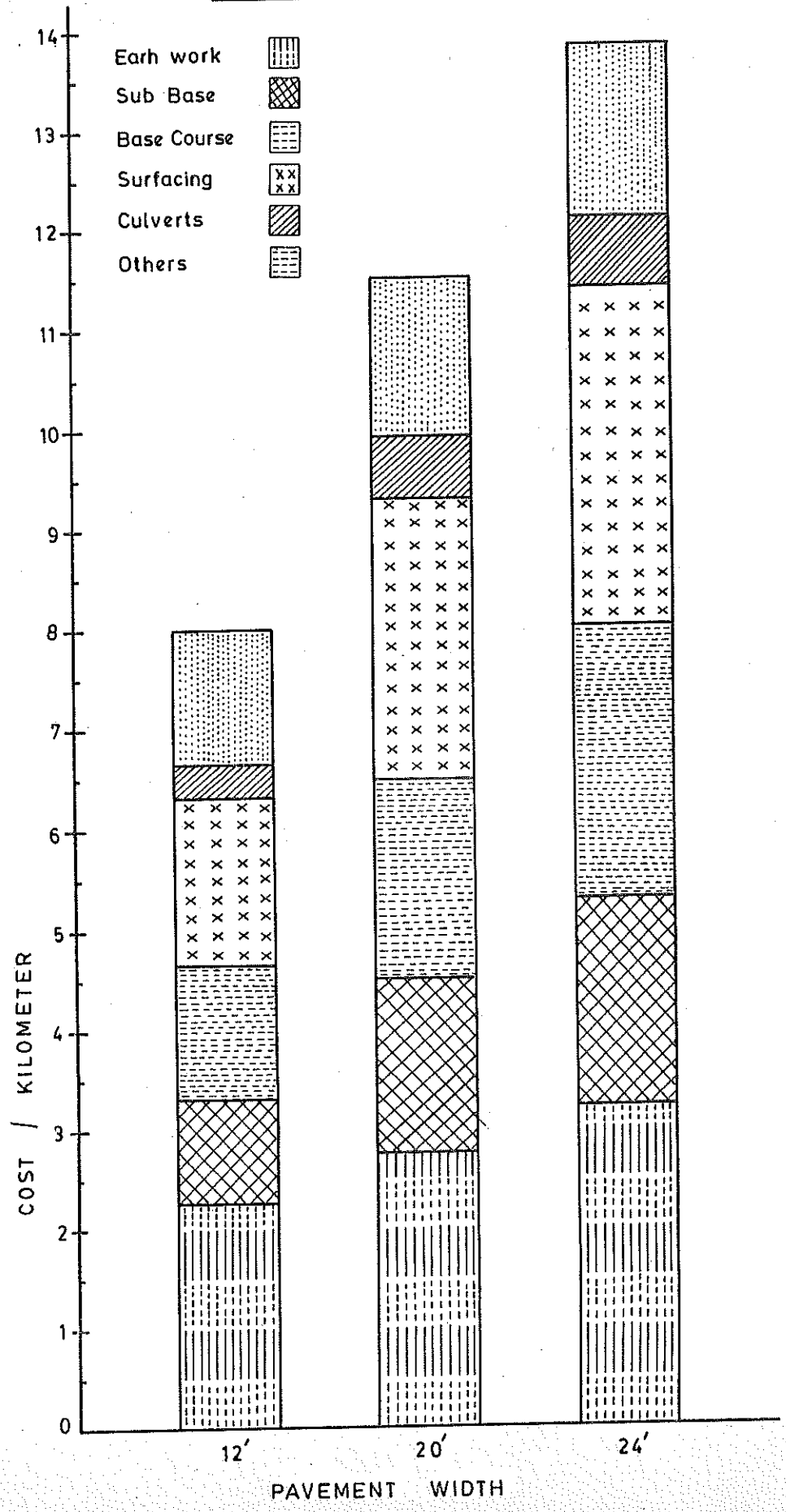


FIG.5 AVERAGE CONSTRUCTION COST / KILOMETER OF ROAD IN BALUCHISTAN



LIST OF TABLES

1. CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PAKISTAN

(Fig. in Rupees)

PROVINCES	PAVEMENT WIDTHS			
	10 FEET	12 FEET	20 FEET	24 FEET
PUNJAB *	419,234	559,544	819,299	941,254
SIND	-	779,827	1,072,794	1,217,363
NWFP	-	683,751	949,313	1,082,719
BALUCHISTAN	-	808,458	1,153,147	1,385,360
PAKISTAN	419,234	707,898	998,641	1,156,678

*NB:- 10 feet wide roads are available in Punjab only.

2. CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PAKISTAN

(Fig. in Percentage)

Sl. No.	I T E M S	PAVEMENT WIDTH			
		10 FEET	12 FEET	20 FEET	24 FEET
1.	2.	3.	4.	5.	6.
1.	Reconnaissance, Survey, Design Planning and Estimation.	1.19	0.71	0.50	0.43
2.	Land Acquisition.	10.73	6.36	4.51	3.89
3.	Earth Work.	17.39	23.48	20.20	19.11
4.	Sub-base.	13.68	14.02	16.56	17.16
5.	Base-course.	17.71	17.59	20.07	21.50
6.	Surfacing.	15.13	15.87	19.31	20.01
7.	Retaining Walls/Breast Walls.	4.72	3.37	2.39	2.06
8.	Culverts (upto 20 feet span).	10.76	6.16	5.99	6.03
9.	Longitudinal Drainage.	2.47	5.99	4.25	3.67
10.	Road Signs.	0.60	0.35	0.25	0.22
11.	Service Road.	0.46	0.74	0.52	0.45
12.	Tool and Plants @ 1% (on item I to II).	0.95	0.95	0.95	0.94
13.	Contingencies and Work charged @ 5% (excluding item 2 & 12).	4.21	4.41	4.50	4.53
	TOTAL:-	100.00	100.00	100.00	100.00

2.1 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PUNJAB

(Fig. in Percentage)

Sl. No.	I T E M S	PAVEMENT WIDTH			
		10 FEET	12 FEET	20 FEET	24 FEET
1.	2.	3.	4.	5.	6.
1.	Reconnaissance, Survey, Design Planning and Estimation.	1.19	0.89	0.61	0.53
2.	Land Acquisition.	10.73	8.04	5.49	4.78
3.	Earth Work.	17.39	14.40	11.94	11.01
4.	Sub-base.	13.68	18.45	21.00	21.94
5.	Base-course.	17.72	23.58	26.83	28.02
6.	Surfacing.	15.13	13.61	15.48	16.18
7.	Retaining Walls/Breast Walls.	4.72	3.54	2.42	2.10
8.	Culverts (upto 20 feet span).	10.76	9.57	9.02	8.43
9.	Longitudinal Drainage.	2.47	1.85	1.26	1.10
10.	Road Signs.	0.60	0.45	0.31	0.27
11.	Service Road.	0.46	0.34	0.23	0.20
12.	Tool and Plants @ 1% (on item I to II).	0.95	0.95	0.95	0.95
13.	Contingencies and Work charged @ 5% (excluding item 2 & 12).	4.20	4.33	4.46	4.49
	TOTAL:-	100.00	100.00	100.00	100.00

2.2 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN SIND

(Fig. in Percentage)

Sl. No.	I T E M S	PAVEMENT WIDTH			
		10 FEET	12 FEET	20 FEET	24 FEET
1.	2.	3.	4.	5.	6.
1.	Reconnaissance, Survey, Design Planning and Estimation.	-	0.64	0.47	0.41
2.	Land Acquisition.	-	5.77	4.19	3.70
3.	Earth Work.	-	18.91	16.69	15.58
4.	Sub-base.	-	16.22	19.65	20.78
5.	Base-course.	-	17.79	21.55	22.79
6.	Surfacing.	-	11.71	14.19	15.01
7.	Retaining Walls/Breast Walls.	-	1.86	1.35	1.19
8.	Culverts (upto 20 feet span).	-	5.10	4.36	4.42
9.	Longitudinal Drainage.	-	15.72	11.43	10.07
10.	Road Signs.	-	0.32	0.23	0.20
11.	Service Road.	-	0.57	0.42	0.37
12.	Tool and Plants @ 1% (on item I to II).	-	0.95	0.95	0.94
13.	Contingencies and Work charged @ 5% (excluding item 2 & 12).	-	4.44	4.52	4.54
	TOTAL:-	-	100.00	100.00	100.00

2.3 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN N.W.F.P.

(Fig. in Percentage)

Sl. No.	I T E M S	PAVEMENT WIDTH			
		10 FEET	12 FEET	20 FEET	24 FEET
1.	2.	3.	4.	5.	6.
1.	Reconnaissance, Survey, Design Planning and Estimation.	-	0.73	0.53	0.46
2.	Land Acquisition.	-	6.58	4.74	4.16
3.	Earth Work.	-	30.73	26.83	24.91
4.	Sub-base.	-	9.06	10.87	11.44
5.	Base-course.	-	13.35	16.03	16.86
6.	Surfacing.	-	16.40	22.06	23.20
7.	Retaining Walls/Breast Walls.	-	6.57	4.73	4.15
8.	Culverts (upto 20 feet span).	-	6.94	5.69	6.65
9.	Longitudinal Drainage.	-	3.60	2.59	2.27
10.	Road Signs.	-	0.37	0.26	0.23
11.	Service Road.	-	0.32	0.23	0.20
12.	Tool and Plants @ 1% (on item I to II).	-	0.95	0.95	0.95
13.	Contingencies and Work charged @ 5% (excluding item 2 & 12).	-	4.40	4.49	4.52
	TOTAL:-	-	100.00	100.00	100.00

2.4 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN BALUCHISTAN

(Fig. in Percentage)

Sl. No.	I T E M S	PAVEMENT WIDTH			
		10 FEET	12 FEET	20 FEET	24 FEET
1.	2.	3.	4.	5.	6.
1.	Reconnaissance, Survey, Design Planning and Estimation.	-	0.62	0.43	0.36
2.	Land Acquisition.	-	5.57	3.90	3.25
3.	Earth Work.	-	28.04	23.87	23.18
4.	Sub-base.	-	13.02	15.21	15.20
5.	Base-course.	-	16.83	17.23	19.56
6.	Surfacing.	-	21.00	24.54	24.51
7.	Retaining Walls/Breast Walls.	-	2.01	1.41	1.17
8.	Culverts (upto 20 feet span).	-	4.18	5.59	5.32
9.	Longitudinal Drainage.	-	1.49	1.05	0.87
10.	Road Signs.	-	0.31	0.22	0.18
11.	Service Road.	-	1.53	1.08	0.90
12.	Tool and Plants @ 1% (on item I to II).	-	0.95	0.94	0.94
13.	Contingencies and Work charged @ 5% (excluding item 2 & 12).	-	4.45	4.53	4.56
	TOTAL:-	-	100.00	100.00	100.00

3. CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PAKISTAN BY PROVINCES
(12 Feet Pavement Width)

(Fig. in Percentage)

Sl. No.	I T E M S	PROVINCES			
		PUNJAB	SIND	N.W.F.P.	BALUCHISTAN
1.	2.	3.	4.	5.	6.
1.	Reconnaissance, Survey, Design Planning and Estimation.	0.89	0.64	0.73	0.62
2.	Land Acquisition.	8.04	5.77	6.58	5.57
3.	Earth Work.	14.40	18.91	30.73	28.04
4.	Sub-base.	18.45	16.22	9.06	13.02
5.	Base-course.	23.58	17.79	13.35	16.83
6.	Surfacing.	13.61	11.71	16.40	21.00
7.	Retaining Walls/Breast Walls.	3.54	1.86	6.57	2.01
8.	Culverts (upto 20 feet span).	9.57	5.10	6.94	4.18
9.	Longitudinal Drainage.	1.85	15.72	3.60	1.49
10.	Road Signs.	0.45	0.32	0.37	0.31
11.	Service Road.	0.34	0.57	0.32	1.53
12.	Tool and Plants @ 1% (on item I to II).	0.95	0.95	0.95	0.95
13.	Contingencies and Work charged @ 5% (excluding item 2 & 12).	4.33	4.44	4.40	4.45
	TOTAL:-	100.00	100.00	100.00	100.00

3.1 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PAKISTAN BY PROVINCES

(20 Feet Pavement Width)

(Fig. in Percentage)

Sl. No.	I T E M S	PROVINCES			
		PUNJAB	SIND	N.W.F.P.	BALUCHISTAN
1.	2.	3.	4.	5.	6.
1.	Reconnaissance, Survey, Design Planning and Estimation.	0.61	0.47	0.53	0.43
2.	Land Acquisition.	5.49	4.19	4.74	3.90
3.	Earth Work.	11.94	16.69	26.83	23.87
4.	Sub-base.	21.00	19.65	10.87	15.21
5.	Base-course.	26.83	21.55	16.03	17.23
6.	Surfacing.	15.48	14.19	22.06	24.54
7.	Retaining Walls/Breast Walls.	2.42	1.35	4.73	1.41
8.	Culverts (upto 20 feet span).	9.02	4.36	5.69	5.59
9.	Longitudinal Drainage.	1.26	11.43	2.59	1.05
10.	Road Signs.	0.31	0.23	0.26	0.22
11.	Service Road.	0.23	0.42	0.23	1.08
12.	Tool and Plants @ 1% (on item I to II).	0.95	0.95	0.95	0.94
13.	Contingencies and Work charged @ 5% (excluding item 2 & 12).	4.46	4.52	4.49	4.53
	TOTAL:-	100.00	100.00	100.00	100.00

3.2 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PAKISTAN BY PROVINCES

(24 Feet Pavement Width)

(Fig. in Percentage)

Sl. No.	ITEMS	PROVINCES			
		PUNJAB	SIND	N.W.F.P.	BALUCHISTAN
1.	2.	3.	4.	5.	6.
1.	Reconnaissance, Survey, Design Planning and Estimation.	0.53	0.41	0.46	0.36
2.	Land Acquisition.	4.78	3.70	4.16	3.25
3.	Earth Work.	11.01	15.58	24.91	23.18
4.	Sub-base.	21.94	20.78	11.44	15.20
5.	Base-course.	28.02	22.79	16.86	19.56
6.	Surfacing.	16.18	15.01	23.20	24.51
7.	Retaining Walls/Breast Walls.	2.10	1.19	4.15	1.17
8.	Culverts (upto 20 feet span).	8.43	4.42	6.65	5.32
9.	Longitudinal Drainage.	1.10	10.07	2.27	0.87
10.	Road Signs.	0.27	0.20	0.23	0.18
11.	Service Road.	0.20	0.37	0.20	0.90
12.	Tool and Plants @ 1% (on item I to II).	0.95	0.94	0.95	0.94
13.	Contingencies and Work charged @ 5% (excluding item 2 & 12).	4.49	4.54	4.52	4.56
	TOTAL:-	100.00	100.00	100.00	100.00

4. CONSTRUCTION COST/KILOMETER OF ROADS IN PUNJAB
(1980 - 87)

(FIG. IN RUPEES)

S. NO:	DISTRICTS	PAVEMENT WIDTH			
		10 FEET	12 FEET	20 FEET	24 FEET
1.	Islamabad	425,627	504,819	674,020	722,360
2.	Attock	394,386	497,725	714,986	817,760
3.	Rawalpindi	568,152	673,145	932,782	1,060,666
4.	Chakwal	485,997	614,008	874,632	813,866
5.	Jhelum	407,669	532,427	765,970	879,477
6.	Gujranwala	597,538	559,794	833,439	966,962
7.	Gujrat	437,972	589,463	865,244	999,662
8.	Sialkot	420,532	563,078	819,949	945,373
9.	Lahore	450,112	578,002	814,218	924,258
10.	Kasur	382,312	490,154	710,516	817,348
11.	Okara	398,885	565,103	898,239	1,004,699
12.	Sheikhupura	428,818	570,963	842,845	975,218
13.	Faisalabad	417,665	568,595	843,011	977,080
14.	Jhang	364,372	472,967	727,890	842,079
15.	Toba-tek-singh	372,261	524,913	796,721	929,987
16.	Bhakkar	323,219	433,057	635,091	734,509
17.	Khushab	271,912	345,842	492,664	563,420
18.	Mianwali	347,480	392,314	557,999	637,989
19.	Sargodha	319,165	394,955	592,325	679,550
20.	Multan	464,882	631,743	942,188	1,094,168
21.	Sahiwal	416,386	596,854	912,312	1,067,204
22.	Vehari	380,271	530,615	802,175	934,764
23.	D. G. Khan	466,055	582,813	821,717	937,711
24.	Leiah	393,297	520,628	772,025	894,171
25.	Muzaffargarh	411,197	554,586	826,664	958,907
26.	Rajanpur	323,821	441,507	655,696	760,425
27.	Bahawalnagar	509,653	724,780	1,111,595	1,302,069
28.	Bahawalpur	436,437	612,840	945,112	1,107,519
29.	Rahim Yar Khan	403,394	578,205	886,037	1,037,427

4.1 CONSTRUCTION COST/KILOMETER OF RAODS IN SIND

(1980 - 87)

(FIG. IN RUPEES)

S. NO:	DISTRICTS	PAVEMENT WIDTH 12 FEET	20 FEET	24 FEET
1.	Karachi	718,527	955,175	1,079,991
2.	Badin	643,862	1,043,800	1,209,931
3.	Dadu	609,975	901,678	1,041,539
4.	Hyderabad	629,626	931,511	1,077,138
5.	Sanghar	763,443	1,161,439	1,355,461
6.	Tharparkar	772,542	1,169,563	1,786,528
7.	Thatta	561,909	817,469	939,762
8.	Jacobabad	556,781	978,642	1,142,765
9.	Khairpur	826,954	1,078,122	1,198,169
10.	Larkana	714,682	1,070,401	1,242,505
11.	Nawabshah	692,534	1,044,294	1,215,500
12.	Shikarpur	555,509	815,942	941,337
13.	Sukkur	642,863	911,326	1,050,939

4.2 CONSTRUCTION COST PER KILOMETER OF ROADS IN NWFP

(1980 - 87)

(FIG. IN RUPEES)

S. NO:	DISTRICTS	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Peshawar	708,658	961,005	1,082,184
2.	Mardan	535,644	831,114	940,546
3.	D. I. Khan	665,527	940,874	1,068,459
4.	Bannu	644,455	916,492	1,045,204
5.	Kohat	679,657	932,719	1,050,356
6.	Karak	901,388	1,268,159	1,430,677
7.	Abbottabad	655,993	913,356	1,033,152
8.	Mansehra	776,191	1,054,313	1,191,740
9.	Kohistan	453,878	548,218	579,666
10.	Malakand	902,877	1,216,664	1,355,548
11.	Chitral	596,640	840,326	956,890
12.	Dir	592,928	822,931	929,751
13.	Swat	663,785	913,631	992,952
14.	FATA	562,807	796,431	907,917

4.3 CONSTRUCTION COST PER KILOMETER OF ROADS IN BALUCHISTAN
(1980 - 87)

(FIG. IN RUPEES)

S. NO:	DISTRICTS	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Kalat	724,265	1,020,204	1,222,561
2.	Khuzdar	836,520	1,270,153	1,481,743
3.	Gwadar	834,441	1,231,720	1,433,260
4.	Panjgur	628,987	835,458	924,703
5.	Quetta	972,482	1,468,447	1,708,515
6.	Loralai	714,582	1,070,468	1,242,084
7.	Pishin	684,947	1,011,548	1,147,301
8.	Zhob	798,090	1,391,777	1,665,641
10.	Sibi	548,251	808,134	940,414
11.	Kachhi	1,189,039	1,656,248	1,930,926
12.	Nasirabad	692,489	1,040,413	1,209,049

N.B.: The data for remaining Districts is not available.

5. INDICES OF CONSTFUCTION COST PER KILOMETER OF ROADS IN PUNJAB
(1980 - 87)

(FIG. IN PERCENTAGE)

S. NO:	DISTRICTS	PAVEMENT WIDTH			
		10 FEET	12 FEET	20 FEET	24 FEET
1.	Islamabad	156.53	145.97	136.81	128.21
2.	Attock	145.04	143.92	145.13	145.14
3.	Rawalpindi	208.95	194.64	189.33	188.25
4.	Chakwal	178.73	177.54	177.53	144.45
5.	Jhelum	149.93	153.95	155.48	156.10
6.	Gujranwala	219.75	161.86	169.17	171.62
7.	Gujrat	161.07	170.44	175.63	177.43
8.	Sialkot	154.66	162.81	166.43	167.79
9.	Lahore	165.54	167.13	165.27	164.04
10.	Kasur	140.60	141.73	144.22	145.07
11.	Okara	146.70	163.40	182.32	178.32
12.	Sheikhupura	157.70	165.09	171.08	173.09
13.	Faisalabad	153.60	164.41	171.11	173.42
14.	Jhang	134.00	136.76	147.75	149.46
15.	Toba-tek-singh	136.90	151.78	161.72	165.06
16.	Bhakkar	118.87	125.22	128.91	130.37
17.	Khushab	100.00	100.00	100.00	100.00
18.	Mianwali	127.79	113.43	113.26	113.23
19.	Sargodha	117.38	114.20	120.23	120.61
20.	Multan	170.97	182.67	191.24	194.20
21.	Sahiwal	153.13	172.58	185.18	189.42
22.	Vehari	139.85	153.30	162.82	165.91
23.	D.G.Khan	171.40	168.52	166.79	166.43
24.	Leiah	144.64	150.54	156.70	158.70
25.	Muzaffargarh	151.22	160.36	167.79	170.19
26.	Rajanpur	119.09	127.66	133.09	134.97
27.	Bahawalnagar	187.43	209.57	225.63	231.10
28.	Bahawalpur	160.51	177.20	191.84	196.57
29.	Rahim Yar Khan	148.35	167.19	179.85	184.13

NB: Khushab is taken as base.

5.1 INDICES OF CONSTRUCTION COST PER KILOMETER OF ROADS IN SIND
(1980 - 87)

(FIG. IN PERCENTAGE)

S. NO:	DISTRICTS	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Karachi	127.87	116.85	114.92
2.	Badin	114.58	127.69	128.75
3.	Dadu	108.55	110.30	110.83
4.	Hyderabad	112.05	113.95	114.62
5.	Sanghar	135.87	142.08	144.23
6.	Tharparkar	137.49	143.07	190.10
7.	Thatta	100.00	100.00	100.00
8.	Jacobabad	116.88	119.72	121.60
9.	Khairpur	147.17	131.89	127.50
10.	Larkana	127.19	130.94	132.21
11.	Nawab Shah	123.25	127.75	128.28
12.	Shikarpur	98.86	99.81	100.17
13.	Sukkur	114.41	111.48	111.83

NB: Thatta is taken as base.

5.2 INDICES OF CONSTRUCTION COST PER KILOMETER OF ROADS IN NWFP (1980 - 87)

(FIG. IN PERCENTAGE)

S. NO:	DISTRICTS	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Peshawar	156.13	175.30	186.69
2.	Mardan	118.01	151.60	162.25
3.	D.I. Khan	146.63	171.62	184.32
4.	Bannu	141.99	167.18	180.31
5.	Kohat	149.74	170.19	181.20
6.	Karak	198.60	231.32	246.81
7.	Abbottabad	144.53	166.60	178.23
8.	Manshera	171.01	192.32	205.59
9.	Kohistan	100.00	100.00	100.00
10.	Malakand	198.93	221.93	233.85
11.	Chitral	131.45	153.28	165.08
12.	Dir	130.64	150.10	160.39
13.	Swat	146.25	166.65	171.30
14.	FATA	124.00	145.28	156.63

NB: Kohistan is taken as base.

5.3 INDICES OF CONSTRUCTION COST PER KILOMETER OF ROADS IN BALUCHISTAN

(1980 - 87)

(FIG. IN PERCENTAGE)

S. NO:	DISTRICTS	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Kalat	132.10	126.24	130.00
2.	Khuzdar	152.58	157.17	157.56
3.	Gwadar	152.20	152.42	152.41
4.	Panjgur	114.73	103.38	98.33
5.	Quetta	177.38	181.71	181.68
6.	Loralai	130.34	132.46	132.08
7.	Pishin	124.93	125.17	122.00
8.	Zhob	145.57	172.22	177.12
9.	Sibi	100.00	100.00	100.00
10.	Kachhi	216.88	204.95	205.33
11.	Nasirabad	126.31	128.74	128.57

N.B. :1) The data for remaining Districts is not available.

2) Sibi is taken as base.

6. INDICES OF CONSTRUCTION COST/KILOMETER OF ROADS IN PUNJAB

S. NO:	DISTRICTS	PAVEMENT WIDTH 10 FEET	12 FEET	20 FEET	24 FEET
1.	Islamabad	84.31	100.00	133.52	143.09
2.	Attock	79.24	100.00	143.65	164.30
3.	Rawalpindi	84.40	100.00	138.57	157.57
4.	Chakwal	79.15	100.00	142.45	132.55
5.	Jhelum	76.57	100.00	143.86	165.18
6.	Gujranwala	106.74	100.00	148.88	172.74
7.	Gujrat	74.30	100.00	146.79	169.59
8.	Sialkot	74.68	100.00	145.62	167.89
9.	Lahore	77.87	100.00	140.87	159.91
10.	Kasur	78.00	100.00	144.96	166.75
11.	Okara	70.59	100.00	158.95	177.79
12.	Sheikhupura	75.10	100.00	147.62	170.80
13.	Faisalabad	73.46	100.00	148.26	171.84
14.	Jhang	77.04	100.00	153.90	178.04
15.	Toba-tek-Singh	70.92	100.00	151.78	177.17
16.	Bhakkar	74.64	100.00	146.65	169.61
17.	Khushab	78.62	100.00	142.45	162.91
18.	Mianwali	88.57	100.00	142.13	162.62
19.	Sargodha	80.81	100.00	149.97	172.06
20.	Multan	73.59	100.00	149.14	173.20
21.	Sahiwal	69.76	100.00	152.85	178.80
22.	Vehari	71.67	100.00	151.18	176.17
23.	D. G. Khan	79.97	100.00	140.99	160.89
24.	Leiah	75.54	100.00	148.29	171.75
25.	Muzaffargarh	74.14	100.00	149.06	172.91
26.	Rajanpur	73.34	100.00	148.51	172.23
27.	Bahawalnagar	70.32	100.00	153.37	179.65
28.	Bahawalpur	71.22	100.00	154.22	180.72
29.	Rahim-Yar-Khan	69.77	100.00	153.24	179.42

6.1 INDICES OF CONSTRUCTION COST/KILOMETER OF ROADS IN SIND

S. NO:	DISTRICTS	PAVEMENT WIDTH		
		12 FEET	24 FEET	24 FEET
1.	Karachi	100.00	132.94	150.31
2.	Badin	100.00	162.12	187.92
3.	Dadu	100.00	147.82	170.75
4.	Hyderabad	100.00	147.95	171.07
5.	Sanghar	100.00	152.13	177.55
6.	Tharparkar	100.00	151.39	231.25
7.	Thatta	100.00	145.48	167.24
8.	Jacobabad	100.00	149.00	173.99
9.	Khairpur	100.00	130.37	144.89
10.	Larkana	100.00	149.77	173.85
11.	Nawabshah	100.00	150.79	175.51
12.	Shikarpur	100.00	146.88	169.45
13.	Sukkur	100.00	141.76	163.48

6.2 INDICES OF CONSTRUCTION COST/KILOMETER OF ROADS IN N.W.F.P.

S. NO:	DISTRICTS	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Peshawar	100.00	135.61	152.71
2.	Mardan	100.00	155.16	175.59
3.	D. I. Khan	100.00	175.65	199.47
4.	Bannu	100.00	142.21	162.18
5.	Kohat	100.00	137.23	154.54
6.	Karak	100.00	140.69	158.72
7.	Abbottabad	100.00	139.23	157.49
8.	Mansehra	100.00	135.83	153.54
9.	Kohistan*	100.00	120.79	127.71
10.	Malakand	100.00	134.75	150.14
11.	Chitral	100.00	140.84	160.38
12.	Dir	100.00	138.79	156.81
13.	Swat	100.00	137.64	149.59
14.	FATA	100.00	141.51	161.32

6.3 INDICES OF CONSTRUCTION COST/KILOMETER OF ROADS IN BALUCHISTAN

S. NO:	DISTRICTS	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Kalat	100.00	140.86	168.80
2.	Khuzdar	100.00	151.84	177.13
3.	Gwadar	100.00	147.61	171.76
4.	Panjgur	100.00	132.83	147.01
5.	Quetta	100.00	150.99	175.69
6.	Loralai	100.00	149.80	173.82
7.	Pishin	100.00	147.68	167.50
8.	Zhob	100.00	174.39	208.70
9.	Sibi	100.00	147.40	171.53
10.	Kachhi	100.00	139.29	162.39
11.	Nasirabad	100.00	150.24	174.59

7. INDICES OF COST/KILOMETER OF ROADS FOR DIFFERENT PAVEMENT WIDTH IN PUNJAB

S. NO:	DESCRIPTION	PAVEMENT WIDTH			
		10 FEET	12 FEET	20 FEET	24 FEET
1.	Earth Work	90.47	100.00	121.43	128.57
2.	Sub-Base	55.56	100.00	166.66	199.99
3.	Base-Course	56.29	100.00	166.59	199.90
4.	Surfacing	83.53	100.00	166.63	200.12
5.	Culverts	84.24	100.00	138.04	148.18
6.	Others	93.04	100.00	112.89	118.99

7.1 INDICES OF COST/KILOMETER OF ROADS FOR DIFFERENT PAVEMENT WIDTH IN SIND

S. NO:	DESCRIPTION	PAVEMENT WIDTH 12 FEET	20 FEET	24 FEET
1.	Earth Work	100.00	121.43	128.57
2.	Sub-Base	100.00	166.66	199.99
3.	Base-Course	100.00	166.59	199.99
4.	Surfacing	100.00	166.66	200.00
5.	Culverts	100.00	117.82	135.44
6.	Others	100.00	107.03	110.49

7.2 INDICES OF COST/KILOMETER OF ROADS FOR DIFFERENT PAVEMENT WIDTH IN N.W.F.P.

S. NO:	DESCRIPTION	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Earth Work	100.00	121.25	128.37
2.	Sub-Base	100.00	166.66	199.99
3.	Base-Course	100.00	166.66	199.99
4.	Surfacing	100.00	186.61	223.92
5.	Culverts	100.00	113.96	151.82
6.	Others	100.00	109.34	114.04

7.3 INDICES OF COST/KILOMETER OF ROADS FOR DIFFERENT PAVEMENT WIDTH IN BALUCHISTAN

S. NO:	DESCRIPTION	PAVEMENT WIDTH		
		12 FEET	20 FEET	24 FEET
1.	Earth Work	100.00	121.43	141.66
2.	Sub-Base	100.00	166.66	199.99
3.	Base-Course	100.00	145.98	199.14
4.	Surfacing	100.00	166.65	199.98
5.	Culverts	100.00	190.84	218.11
6.	Others	100.00	114.25	123.86

8. CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PUNJAB

(Fig. in Percentage)

S. No.	Description / District	PAVEMENT WIDTH 10 FEET												
		Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Islamabad	1.17	10.57	15.43	5.96	8.09	14.02	14.06	12.54	12.40	0.59	-	0.96	4.21	100
2.	Attock	1.27	11.41	21.07	9.14	14.75	17.58	9.54	6.78	2.48	0.63	0.23	0.95	4.17	100
3.	Rawalpindi	0.88	7.92	21.53	5.67	9.65	14.32	10.35	20.38	3.33	0.44	0.24	0.95	4.34	100
4.	Chakwal	1.03	9.26	12.35	9.16	12.70	15.27	12.78	20.04	1.67	0.51	-	0.95	4.28	100
5.	Jhelum	1.23	11.04	19.15	9.96	14.04	14.85	2.67	17.41	3.91	0.61	-	0.95	4.18	100
6.	Gujranwala	1.17	10.50	18.39	14.15	17.64	18.93	2.83	8.75	0.99	0.58	0.90	0.95	4.22	100
7.	Gujrat	1.14	10.27	18.96	12.81	16.64	15.76	2.57	13.49	2.61	0.57	-	0.95	4.23	100
8.	Sialkot	1.19	10.70	17.11	13.05	16.57	11.87	1.73	17.22	4.27	0.60	0.53	0.95	4.21	100
9.	Lahore	1.11	10.00	14.70	10.88	16.55	10.81	14.19	9.99	6.02	0.56	-	0.95	4.24	100
10.	Kasur	1.31	11.77	20.95	11.40	15.90	17.56	5.85	7.46	1.28	0.65	0.76	0.95	4.16	100
11.	Okara	1.25	11.28	12.99	18.44	23.55	15.23	2.79	8.71	-	0.63	-	0.95	4.18	100
12.	Sheikhupura	1.16	10.49	19.89	11.94	17.47	13.25	-	20.05	-	0.58	-	0.95	4.22	100
13.	Faisalabad	1.20	10.77	17.98	19.58	15.37	14.92	3.30	8.37	2.76	0.60	-	0.95	4.20	100
14.	Jhang	1.37	12.35	17.52	14.76	17.88	15.74	4.34	9.02	0.94	0.69	0.31	0.95	4.13	100
15.	Toba Tek Singh	1.34	12.09	16.96	18.70	22.27	16.35	0.82	5.71	-	0.67	-	0.95	4.14	100

Contd.

(Fig. in Percentage)

PAVEMENT WIDTH 10 FEET

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
16.	Bhakkar	1.55	13.92	18.80	13.05	17.42	15.58	-	13.25	-	0.77	0.65	0.95	4.06	100
17.	Khushab	1.84	16.55	23.36	9.35	13.46	15.42	-	12.40	-	0.92	1.83	0.95	3.92	100
18.	Mianwali	1.44	12.95	18.52	8.22	12.74	13.01	2.98	21.68	2.38	0.73	0.30	0.95	4.10	100
19.	Sargodha	1.57	14.10	21.04	11.42	14.70	16.42	3.94	8.29	2.22	0.78	0.52	0.95	4.05	100
20.	Multan	1.08	9.68	16.68	16.16	17.94	17.82	2.14	8.43	4.09	0.54	0.24	0.95	4.25	100
21.	Sahiwal	1.20	10.81	16.29	18.63	23.70	17.10	-	5.96	-	0.60	0.56	0.95	4.20	100
22.	Vehari	1.31	11.83	20.04	18.16	20.56	17.33	-	5.01	-	0.66	-	0.95	4.15	100
23.	D.G Khan	1.07	9.65	17.73	7.82	12.31	14.13	12.37	18.92	-	0.54	0.26	0.95	4.25	100
24.	Leiah	1.29	11.62	21.89	15.42	16.54	17.66	0.70	7.79	0.99	0.66	0.26	0.95	4.23	100
25.	Rajanpur	1.54	13.90	17.47	16.30	18.50	12.69	-	13.83	-	0.77	-	0.95	4.05	100
26.	Bhawalnagar	0.98	8.83	13.77	16.66	24.92	14.88	-	14.22	-	0.49	-	0.95	4.30	100
27.	Bhawalpur	1.15	10.31	14.63	18.34	26.01	14.62	-	9.20	-	0.57	-	0.95	4.22	100
28.	Rahim Yar Khan	1.24	11.16	14.96	20.01	23.85	15.38	-	7.65	-	0.62	-	0.95	4.18	100
29.	Muzaffargarh	1.22	10.94	22.06	14.09	17.84	18.51	0.73	8.85	-	0.61	-	0.95	4.20	100

8.1 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PUNJAB

(Fig. in Percentage)

PAVEMENT WIDTH 12 FEET

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Islamabad	0.99	8.91	14.38	9.04	12.29	14.19	11.85	12.16	10.45	0.50	-	0.95	4.29	100
2.	Attock	1.00	8.96	18.27	12.92	20.83	16.55	7.49	6.12	1.94	0.50	0.18	0.95	4.29	100
3.	Rawalpindi	0.74	6.69	20.08	8.62	14.66	14.50	8.74	17.24	2.81	0.37	0.20	0.95	4.40	100
4.	Chakwal	0.81	7.33	10.81	13.06	18.09	14.50	10.11	18.24	1.32	0.41	--	0.95	4.37	100
5.	Jhelum	0.94	8.45	16.21	13.73	19.34	13.64	2.04	16.92	2.99	0.47	-	0.95	4.32	100
6.	Gujranwala	0.87	7.82	15.14	18.97	23.66	16.92	2.11	7.51	0.74	0.43	0.68	0.95	4.20	100
7.	Gujrat	0.85	7.63	15.57	17.13	22.26	14.05	1.91	12.94	1.94	0.42	-	0.95	4.35	100
8.	Sialkot	0.89	7.99	14.13	17.55	22.28	10.64	1.29	15.93	3.19	0.44	0.40	0.95	4.34	100
9.	Lahore	0.87	7.78	12.65	15.52	23.20	10.11	11.05	8.68	4.68	0.43	-	0.95	4.35	100
10.	Kasur	1.02	9.18	18.06	16.01	22.32	16.44	4.56	5.08	1.00	0.51	0.59	0.95	4.28	100
11.	Okara	0.88	7.96	10.13	23.43	29.92	12.90	1.97	7.07	-	0.44	-	0.95	4.35	100
12.	Sheikhupura	0.88	7.88	16.51	16.13	23.61	11.94	-	17.32	-	0.44	-	0.95	4.34	100
13.	Faisalabad	0.88	7.91	14.59	25.88	20.33	13.15	2.42	7.08	2.03	0.44	-	0.95	4.34	100
14.	Jhang	1.01	9.13	14.32	19.63	23.79	13.96	3.21	8.48	0.69	0.51	0.23	0.95	4.09	100
15.	Toba Tek Singh	0.95	8.57	13.29	23.87	28.43	13.91	0.58	4.66	-	0.48	-	0.95	4.31	100

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PAVEMENT WIDTH 12 FEET (Fig. in Percentage)

S. No.	Description / District	Reconnaissance, Survey, Design etc	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
16.	Bhakar	1.15	10.39	15.51	17.54	23.85	13.95	-	11.37	-	0.58	0.49	0.95	4.22	100
17.	Khushab	1.45	13.01	20.30	13.23	19.05	14.55	-	11.21	-	0.71	1.44	0.95	4.10	100
18.	Mianwali	1.27	11.47	18.13	13.08	20.32	13.83	2.64	11.12	2.11	0.64	0.27	0.95	4.17	100
19.	Sargodha	1.21	10.92	18.00	15.91	20.48	15.26	3.05	7.29	1.72	0.61	0.40	0.95	4.20	100
20.	Multan	0.79	7.12	13.56	21.40	23.77	15.74	1.58	7.12	3.02	0.39	0.18	0.95	4.38	100
21.	Sahiwal	0.84	7.54	12.56	23,40	29.76	14.32	-	5.46	-	0.42	0.39	0.95	4.36	100
22.	Vehari	0.94	8.48	15.87	23.42	26.52	14.90	-	4.13	-	0.47	-	0.95	4.32	100
23.	D.G Khan	0.86	7.72	15.67	11.26	17.72	13.56	9.89	17.39	-	0.42	0.21	0.95	4.35	100
24.	Leiah	0.96	8.64	18.00	20.64	22.14	15.76	0.52	6.67	0.73	0.48	0.19	0.95	4.32	100
25.	Rajanpur	1.13	10.19	14.16	21.51	24.42	11.17	-	11.66	-	0.57	-	0.95	4.24	100
26.	Bhawalnagar	0.69	6.21	10.70	21.09	31.54	12.56	-	11.50	-	0.34	-	0.95	4.42	100
27.	Bhawalpur	0.82	7.34	11.51	23.50	33.32	12.48	-	5.31	-	0.41	-	0.95	4.36	100
28.	Rahim Yar Khan	0.86	7.78	11.54	25.12	29.95	12.87	-	6.14	-	0.43	-	0.95	4.36	100
29.	Muzeffagarh	0.90	8.11	18.08	18.81	23.81	16.47	0.54	7.55	-	0.45	-	0.95	4.33	100

8.2 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PUNJAB

(Fig. in Percentage)

PAVEMENT WIDTH 20 FEET

S. No.	Description / District	Reconnaissance, Survey, Design etc	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Islamabad	0.74	6.68	13.08	11.29	15.33	17.71	8.88	12.74	7.83	0.37	-	0.95	4.40	100
2.	Attock	0.70	6.99	15.60	15.13	24.01	19.37	5.26	6.02	1.37	0.35	0.13	0.95	4.12	100
3.	Rawalpindi	0.54	4.82	17.60	10.37	17.63	17.44	6.31	17.42	2.03	0.27	0.14	0.95	4.48	100
4.	Chakwal	0.57	5.15	9.21	15.28	21.17	16.97	7.10	17.93	0.93	0.28	-	0.95	4.46	100
5.	Jhelum	0.65	5.87	13.68	15.91	22.41	15.80	1.42	16.46	2.08	0.33	-	0.95	4.44	100
6.	Gujranwala	0.60	5.40	12.69	21.82	27.21	19.46	1.45	4.67	0.51	0.30	0.46	0.95	4.48	100
7.	Gujrat	0.58	5.20	12.88	19.45	25.27	15.95	1.30	12.34	1.32	0.29	-	0.95	4.47	100
8.	Sialkot	0.61	5.49	11.78	20.08	25.50	12.17	0.89	15.31	2.19	0.30	0.27	0.95	4.46	100
9.	Lahore	0.61	5.53	10.91	18.04	27.45	11.96	7.84	8.62	3.33	0.31	-	0.95	4.45	100
10.	Kasur	0.70	6.33	15.13	18.41	25.67	18.90	3.15	4.91	0.69	0.33	0.41	0.95	4.42	100
11.	Okara	0.58	5.23	8.08	25.67	32.77	14.15	1.30	6.50	-	0.30	-	0.95	4.47	100
12.	Sheikhupura	0.59	5.34	9.25	31.99	18.22	13.48	-	16.41	-	0.30	-	0.95	4.46	100
13.	Faisalabad	0.59	5.34	11.95	29.10	22.85	14.79	1.62	6.68	1.37	0.30	-	0.95	4.46	100
14.	Jhang	0.69	6.18	11.77	22.16	25.86	15.75	3.20	8.05	0.47	0.34	0.16	0.95	4.42	100
15.	Toba Tek Singh	0.63	5.65	10.63	26.21	31.21	15.28	0.38	4.29	-	0.32	-	0.95	4.45	100

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PAVEMENT WIDTH 20 FEET (Fig. in Percentage)

S. No.	Description / District	Reconnaissance, Survey, Design etc	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
16.	Bhakkar	0.79	7.09	12.84	19.93	26.59	15.85	-	10.86	-	0.39	0.33	0.95	4.95	100
17.	Khushab	1.01	9.13	17.30	15.48	22.30	17.02	-	11.01	-	0.51	1.01	0.95	4.95	100
18.	Mianwali	0.90	8.06	15.48	15.35	23.81	16.20	1.85	10.95	1.48	0.45	0.19	0.95	4.33	100
19.	Sargodha	0.84	7.60	15.21	18.45	23.76	17.70	2.12	7.11	1.20	0.42	0.28	0.95	4.36	100
20.	Multan	0.53	4.78	11.04	23.90	26.56	17.59	1.06	6.69	2.02	0.27	0.12	0.95	4.49	100
21.	Sahiwal	0.55	4.93	9.98	25.51	32.45	15.61	-	5.01	-	0.27	0.26	0.95	4.48	100
22.	Vehari	0.62	5.61	12.75	25.82	29.24	16.43	-	3.82	-	0.31	-	0.95	4.45	100
23.	D.G Khan	0.60	5.48	13.48	13.31	20.95	16.03	7.02	17.27	-	0.30	0.15	0.95	4.46	100
24.	Leiah	0.65	5.83	14.74	23.20	24.89	17.72	0.35	6.29	0.49	0.32	0.13	0.95	4.44	100
25.	Rajanpur	0.76	6.86	11.58	24.14	27.41	12.53	-	11.00	-	0.38	-	0.95	4.39	100
26.	Bahawalnagar	0.45	4.05	8.47	22.92	34.27	13.65	-	10.50	-	0.22	-	0.95	4.52	100
27.	Bahwalpur	0.53	4.77	9.08	25.46	36.10	13.52	-	4.83	-	0.26	-	0.95	4.50	100
28.	Rahim Yar Khan	0.56	5.08	9.14	27.33	32.58	14.00	-	5.61	-	0.28	-	0.95	4.47	100
29.	Muzaffargarh	0.60	5.44	14.73	21.03	26.62	18.41	0.36	7.07	-	0.30	-	0.95	4.49	100

8.3 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PUNJAB

(Fig. in Percentage)

S. No.	Description / District	PAVEMENT WIDTH 24 FEET													
		Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Islamabad	0.66	5.95	12.35	12.08	16.41	18.95	7.92	12.99	6.98	0.33	-	0.95	4.43	100
2.	Attock	0.61	5.50	14.44	15.87	25.60	20.34	4.60	6.02	1.19	0.31	0.11	0.95	4.46	100
3.	Rawalpindi	0.47	4.24	16.38	10.94	18.61	18.69	5.55	17.51	1.78	0.24	0.13	0.95	4.51	100
4.	Chakwal	0.50	4.54	8.60	16.17	22.40	17.77	6.28	18.07	0.82	0.25	-	0.95	3.65	100
5.	Jhelum	0.57	5.12	12.61	16.63	23.42	16.51	1.24	16.39	1.81	0.28	-	0.95	4.47	100
6.	Gujranwal	0.52	4.65	11.58	22.57	28.15	20.13	1.25	4.60	0.44	0.26	0.40	0.95	4.50	100
7.	Gujrat	0.50	4.50	11.80	20.20	26.25	16.57	1.12	12.21	1.15	0.25	-	0.95	4.50	100
8.	Sialkot	0.53	4.76	10.82	20.90	26.54	12.67	0.77	15.18	1.90	0.26	0.23	0.95	4.49	100
9.	Lahore	0.54	4.84	10.12	18.97	20.86	12.57	6.87	8.64	2.91	0.27	-	0.95	4.46	100
10.	Kasur	0.61	5.51	13.92	19.20	26.77	19.71	2.74	4.87	0.60	0.30	0.35	0.95	4.47	100
11.	Okara	0.50	4.48	7.33	26.36	33.66	14.50	1.11	6.36	-	0.25	-	0.95	4.50	100
12.	Sheikupura	0.51	4.61	12.43	18.89	27.65	13.98	-	16.22	-	0.26	-	0.95	4.50	100
13.	Faisalabad	0.51	4.61	10.92	30.13	23.66	15.31	1.41	6.56	1.18	0.26	-	0.95	4.50	100
14.	Jhang	0.59	5.34	10.78	22.99	27.85	16.34	1.88	7.80	0.40	0.30	0.32	0.95	4.46	100
15.	Toba Tek Singh	0.54	4.84	9.65	26.95	32.09	15.68	0.33	4.21	-	0.27	-	0.95	4.49	100

Contd.

CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN PUNJAB

(Fig. in Percentage)

S. No.	Description / District	PAVEMENT WIDTH 24 FEET													
		Reconnaissance, Survey, Design etc	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
16.	Bhakkar	0.66	6.13	11.76	20.67	27.59	16.45	-	10.73	-	0.34	0.29	0.95	4.43	100
17.	Khushab	0.89	7.98	16.02	16.25	23.38	17.86	-	11.01	-	0.44	0.88	0.95	4.34	100
18.	Mianwali	0.78	7.06	14.34	16.09	24.98	17.01	1.62	10.94	1.30	0.39	0.16	0.95	4.38	100
19.	Sargodha	0.74	6.62	14.04	19.30	24.85	18.52	1.85	7.08	1.04	0.37	0.24	0.95	4.40	100
20.	Multan	0.46	4.11	10.07	24.71	27.44	18.18	0.91	6.58	1.74	0.23	0.10	0.95	4.52	100
21.	Sahiwal	0.47	4.22	9.03	26.17	33.29	16.00	-	4.90	-	0.23	0.22	0.95	4.52	100
22.	Vehari	0.53	4.81	11.58	26.59	30.11	16.92	-	3.75	-	0.27	-	0.95	4.49	100
23.	D.G Khan	0.60	5.37	14.01	3.73	24.65	18.87	6.88	19.36	-	0.30	0.14	1.06	5.03	100
24.	Leiah	0.55	5.03	13.48	24.03	25.79	18.36	0.30	6.21	0.43	0.28	0.11	0.95	4.48	100
25.	Rajanpur	0.66	5.92	10.57	24.98	28.36	12.97	-	10.83	-	0.33	-	0.95	4.43	100
26.	Bahawalnagar	0.38	3.46	9.66	23.48	35.11	13.96	-	10.24	-	0.19	-	0.95	4.55	100
27.	Bhawalpur	0.45	4.07	8.20	26.06	36.96	13.84	-	4.71	-	0.23	-	0.95	4.53	100
28.	Rahim Yar Khan	0.48	4.34	8.27	28.00	33.39	14.35	-	5.47	-	0.24	-	0.95	4.51	100
29.	Muzaffargarh	0.52	4.69	13.44	21.75	27.54	19.07	0.31	6.98	-	0.26	-	0.95	4.49	100

8.4 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN SIND

(Fig. in Percentage)

PAVEMENT WIDTH 12 FEET

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Karachi	0.70	6.26	23.21	13.99	15.82	11.93	2.01	7.45	12.40	0.35	0.51	0.95	4.42	100.00
2.	Badin	0.70	6.26	19.01	21.66	23.10	11.58	-	11.46	-	0.35	0.51	0.95	4.42	100.00
3.	Dadu	0.82	7.38	20.62	19.30	21.24	17.58	-	3.54	3.05	0.41	0.75	0.95	4.36	100.00
4.	Hyderabad	0.79	7.15	22.30	20.44	24.39	11.92	-	6.55	-	0.40	0.74	0.95	4.37	100.00
5.	Sanghar	0.65	5.89	17.21	23.40	25.12	17.22	-	4.17	-	0.33	0.62	0.95	4.44	100.00
6.	Mirpurkhas	0.65	5.82	18.96	25.39	27.35	11.49	-	4.01	-	0.32	0.62	0.95	4.44	100.00
7.	Thatta	0.89	8.01	25.79	18.46	19.26	15.49	-	6.27	-	0.44	0.10	0.95	4.34	100.00
8.	Jacobabad	0.76	6.85	19.14	22.03	23.81	14.76	-	6.22	-	0.38	0.71	0.95	4.39	100.00
9.	Khairpur	0.60	5.44	17.68	12.54	11.85	11.26	-	2.75	31.45	0.30	0.72	0.95	4.46	100.00
10.	Larkana	0.70	6.30	21.27	22.77	25.00	13.15	-	4.46	-	0.35	0.63	0.95	4.42	100.00
11.	Nawabshah	0.72	6.50	17.82	23.20	26.08	13.20	-	6.12	-	0.36	0.64	0.95	4.41	100.00
12.	Shikarpur	0.90	8.10	22.93	19.59	21.02	14.77	-	5.99	-	0.45	0.97	0.95	4.33	100.00
13.	Sukkur	0.78	7.00	23.92	17.47	19.37	16.24	-	8.72	-	0.39	0.78	0.95	4.38	100.00

8.5 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN SIND

(Fig. in Percentage)

PAVEMENT WIDTH 20 FEET

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Karachi	0.52	4.71	16.20	17.54	19.83	19.97	1.52	4.30	9.33	0.26	0.38	0.95	4.49	100.00
2.	Badin	0.48	4.34	15.98	25.00	26.65	13.36	-	8.11	-	0.24	0.35	0.95	4.54	100.00
3.	Dadu	0.55	4.59	16.94	21.76	23.95	19.82	-	3.75	2.06	0.28	0.51	0.95	4.48	100.00
4.	Hyderabad	0.54	4.83	18.30	23.03	27.48	13.43	-	6.19	-	0.27	0.50	0.95	4.48	100.00
5.	Sanghar	0.43	3.87	13.74	25.64	27.52	18.86	-	3.84	-	0.21	0.41	0.95	4.53	100.00
6.	Mirpurkhas	0.43	3.85	15.21	27.95	30.10	12.65	-	3.71	-	0.21	0.41	0.95	4.53	100.00
7.	Thatta	0.61	5.50	21.53	21.14	22.07	16.71	-	6.04	-	0.31	0.69	0.95	4.45	100.00
8.	Jacobabad	0.51	4.60	15.59	24.64	26.64	16.51	-	5.33	-	0.26	0.47	0.95	4.50	100.00
9.	Khairpur	0.46	4.17	16.47	16.03	15.15	14.39	-	2.96	24.12	0.23	0.55	0.95	4.52	100.00
10.	Larkana	0.47	4.20	17.24	25.34	27.82	14.63	-	4.17	-	0.23	0.43	0.95	4.52	100.00
11.	Nawabshah	0.48	4.31	14.35	25.64	28.83	14.58	-	5.65	-	0.24	0.43	0.95	4.54	100.00
12.	Shikarpur	0.61	5.51	18.96	22.23	23.85	16.76	-	5.71	-	0.31	0.66	0.95	4.45	100.00
13.	Sukkur	0.55	4.94	20.49	20.54	22.77	19.10	-	5.36	-	0.27	0.55	0.95	4.48	100.00

8.6 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN SIND

PAVEMENT WIDTH 24-FEET

(Fig. in Percentage)

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Karachi	0.46	4.17	19.86	18.61	21.04	15.88	1.34	4.35	8.25	0.23	0.34	0.94	4.53	100.00
2.	Badin	0.41	3.74	14.59	25.86	27.57	13.82	-	7.99	-	0.21	0.30	0.95	4.56	100.00
3.	Dadu	0.48	4.32	15.53	22.61	24.88	20.59	-	3.67	1.78	0.24	0.44	0.95	4.51	100.00
4.	Hyderabad	0.46	4.18	16.76	23.90	28.52	13.93	-	6.12	-	0.23	0.43	0.95	4.52	100.00
5.	Sanghar	0.36	3.32	12.46	26.36	28.30	19.40	-	3.76	-	0.18	0.35	0.95	4.56	100.00
6.	Mirpurkhas	0.37	3.30	13.82	28.79	31.01	13.03	-	3.64	-	0.18	0.35	0.95	4.56	100.00
7.	Thatta	0.53	4.79	19.83	22.07	23.03	17.44	-	6.00	-	0.27	0.60	0.95	4.49	100.00
8.	Jacobabad	0.44	3.94	14.14	25.33	27.37	16.97	-	5.71	-	0.22	0.40	0.95	4.53	100.00
9.	Khairpur	0.42	3.75	15.69	17.30	16.36	15.54	-	3.04	21.70	0.21	0.50	0.95	4.54	100.00
10.	Larkana	0.40	3.62	15.73	26.20	28.76	15.13	-	4.10	-	0.20	0.37	0.95	4.54	100.00
11.	Nawabshah	0.41	3.70	13.06	26.43	29.72	15.03	-	5.58	-	0.21	0.37	0.95	4.54	100.00
12.	Shikarpur	0.53	4.78	17.40	23.12	24.81	17.44	-	5.65	-	0.26	0.57	0.95	4.49	100.00
13.	Sukkur	0.47	4.28	18.81	21.37	23.69	19.88	-	5.32	-	0.24	0.48	0.95	4.51	100.00

8.7 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN NWFP

PAVEMENT WIDTH 12 FEET (Fig. in Percentage)

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Peshawar	0.71	6.35	41.06	7.06	12.92	16.13	2.47	7.04	0.55	0.35	-	0.94	4.42	100.00
2.	Mardan	0.93	8.41	37.02	9.64	16.72	2.08	6.75	12.42	-	0.46	0.31	0.94	4.32	100.00
3.	D.I. Khan	0.75	6.76	27.82	10.18	15.26	18.16	8.39	6.96	-	0.39	-	0.94	4.39	100.00
4.	Bannu	0.77	6.98	29.59	9.45	16.45	19.96	3.69	7.18	0.22	0.38	-	0.94	4.39	100.00
5.	Kohat	0.74	6.62	26.12	8.82	13.89	17.04	6.82	5.44	8.42	0.36	0.37	0.94	4.42	100.00
6.	Karak	0.55	4.99	35.29	6.31	11.06	18.25	6.62	11.23	-	0.28	-	0.94	4.48	100.00
7.	Abbottabad	0.76	6.86	28.16	8.43	14.56	18.83	10.83	5.86	-	0.38	-	0.94	4.39	100.00
8.	Manshera	0.64	5.79	35.24	9.18	14.16	18.36	7.35	3.56	-	0.33	-	0.94	4.45	100.00
9.	Kohistan	0.11	0.99	91.51	-	-	-	1.73	-	-	0.06	-	0.94	4.66	100.00
10.	Malakand	0.55	4.98	30.46	6.92	11.18	13.43	9.12	7.54	9.74	0.27	0.39	0.94	4.48	100.00
11.	Chitral	0.83	7.55	20.18	10.59	10.66	26.02	12.11	5.92	-	0.43	0.41	0.94	4.36	100.00
12.	Dir	0.84	7.58	36.45	8.12	15.95	17.25	4.97	3.11	-	0.43	-	0.94	4.36	100.00
13.	Swat	0.75	6.78	34.67	7.27	12.32	15.84	3.45	12.42	0.78	0.38	-	0.95	4.39	100.00
14.	FATA	0.89	8.00	24.99	14.09	12.13	21.62	5.25	4.77	2.52	0.44	-	0.95	4.35	100.00

8.8 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN NWFP

(Fig. in Percentage)

PAVEMENT WIDTH 20 FEET

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Peshawar	0.53	4.72	36.32	8.70	15.88	19.85	1.64	6.22	0.44	0.26	-	0.95	4.49	100.00
2.	Mardan	0.60	5.42	28.98	10.36	17.95	22.36	4.35	4.07	-	0.32	0.19	0.95	4.45	100.00
3.	D.I. Khan	0.53	4.78	23.69	12.00	17.99	21.40	5.94	7.77	-	0.27	-	0.94	4.49	100.00
4.	Bannu	0.54	4.92	25.27	11.06	19.28	23.42	2.58	7.09	0.15	0.29	-	0.92	4.48	100.00
5.	Kohat	0.53	4.83	23.09	10.73	16.88	20.69	4.98	6.17	6.14	0.26	0.28	0.94	4.48	100.00
6.	Karak	0.39	3.54	30.45	7.47	13.11	21.62	4.71	13.03	-	0.19	-	0.94	4.55	100.00
7.	Abbottabad	0.54	4.93	24.56	10.08	17.43	22.54	7.77	6.44	-	0.28	-	0.94	4.49	100.00
8.	Manshera	0.47	4.26	31.52	11.25	17.36	22.53	5.42	1.48	-	0.24	-	0.94	4.53	100.00
9.	Kohistan	0.09	0.83	91.99	-	-	-	1.43	-	-	0.05	-	0.94	4.67	100.00
10.	Malakand	0.41	3.69	27.45	8.55	13.84	16.61	6.75	9.48	7.23	0.22	0.28	0.94	4.55	100.00
11.	Chitral	0.59	5.36	17.40	12.55	12.62	30.79	8.59	6.12	-	0.29	0.28	0.94	4.47	100.00
12.	Dir	0.61	5.47	31.88	9.73	19.15	20.72	3.58	3.14	-	0.32	-	0.94	4.46	100.00
13.	Swat	0.54	4.93	30.59	8.81	14.92	19.17	2.51	12.27	0.56	0.27	-	0.95	4.48	100.00
14.	FATA	0.63	5.65	21.45	16.60	14.29	25.46	3.71	4.72	1.78	0.31	-	0.95	4.45	100.00

8.9 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN N.W.F.P.

(Fig. in Percentage)

S. No.	Description / District	PAVEMENT WIDTH 24 FEET													
		Reconnaissance, Survey, Design etc	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Peshawar	0.46	4.16	34.13	9.25	16.93	21.12	1.62	6.29	0.36	0.23	-	0.94	4.51	100.00
2.	Mardan	0.53	4.78	27.11	10.99	19.03	23.71	3.85	4.12	-	0.27	0.17	0.95	4.49	100.00
3.	D. I. Khan	0.46	4.22	22.27	12.68	19.00	22.62	5.22	7.83	-	0.23	-	0.94	4.52	100.00
4.	Bannu	0.48	4.27	24.12	11.54	20.12	24.41	2.25	7.05	0.13	0.24	-	0.92	4.47	100.00
5.	Kohat	0.48	4.28	21.72	11.42	17.98	22.05	4.43	6.25	5.45	0.24	0.25	0.94	4.51	100.00
6.	Karak	0.35	3.15	28.59	7.94	13.94	22.99	4.17	13.19	-	0.17	-	0.94	4.57	100.00
7.	Abbottabad	0.49	4.36	22.99	10.69	18.48	23.91	6.88	6.49	-	0.25	-	0.94	4.52	100.00
8.	Manshera	0.42	3.77	29.52	11.94	18.43	23.93	4.79	1.51	-	0.22	-	0.94	4.53	100.00
9.	Kohistan	0.08	0.78	92.13	-	-	-	1.35	-	-	0.04	-	0.94	4.68	100.00
10.	Malakand	0.36	3.32	26.09	9.31	14.91	17.88	6.06	9.74	6.48	0.19	0.26	0.94	4.56	100.00
11.	Chitral	0.52	4.71	16.18	13.22	13.29	32.44	7.56	6.14	-	0.26	0.25	0.94	4.49	100.00
12.	Dir	0.53	4.84	29.88	10.34	20.35	22.02	3.17	3.18	-	0.26	-	0.94	4.49	100.00
13.	Swat	0.49	4.36	28.70	9.36	15.86	20.39	2.22	12.42	0.50	0.24	-	0.95	4.51	100.00
14.	FATA	0.55	4.96	19.92	17.47	15.04	26.80	3.26	4.74	1.56	0.27	-	0.95	4.48	100.00

8.10 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN BALUCHISTAN

(Fig. in Percentage)

PAVEMENT WIDTH 12 FEET

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Kalat	0.69	6.21	25.42	16.88	19.13	19.70	3.03	3.22	-	0.35	-	0.95	4.42	100.00
2.	Khuzdar	0.59	5.38	18.60	23.77	26.52	15.52	1.16	2.63	-	0.30	0.12	0.95	4.46	100.00
3.	Gwadar	0.60	5.39	26.30	16.24	17.10	23.85	1.81	3.00	-	0.30	-	0.95	4.46	100.00
4.	Punjgur	0.79	7.15	58.77	2.12	13.20	12.24	-	-	-	0.40	-	0.95	4.38	100.00
5.	Quetta	0.51	4.62	20.39	12.02	10.41	41.31	2.17	2.86	-	0.26	-	0.95	4.50	100.00
6.	Loralai	0.70	6.30	23.39	16.74	16.74	28.78	0.48	1.15	-	0.35	-	0.95	4.42	100.00
7.	Pishin	0.73	6.57	17.09	15.83	10.56	13.10	8.64	15.21	1.76	0.36	4.80	0.95	4.40	100.00
8.	Zhob	0.63	5.64	20.10	12.44	15.30	18.94	1.08	20.16	-	0.31	-	0.95	4.45	100.00
9.	Sibi	0.91	8.20	19.63	16.95	15.59	26.36	2.82	3.18	-	0.46	0.61	0.95	4.34	100.00
10.	Kachhi	0.42	3.78	50.04	2.57	17.17	19.78	0.54	-	-	0.21	-	0.95	4.54	100.00
11.	Nasirabad	0.72	6.50	20.52	14.64	20.57	28.73	1.61	0.99	-	0.36	-	0.95	4.41	100.00

8.11 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN BALUCHISTAN

(Fig. in Percentage)

PAVEMENT WIDTH 20 FEET

Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Kalat	0.47	4.24	21.07	19.21	21.76	22.41	2.07	3.08	–	0.23	–	0.95	4.51	100.00
2. Khuzdar	0.39	3.54	14.88	26.09	29.11	17.02	0.77	2.43	–	0.20	0.08	0.94	4.55	100.00
3. Gwadar	0.41	3.65	21.64	18.34	19.30	26.93	1.22	2.85	–	0.20	–	0.91	4.55	100.00
4. Punjgur	0.59	5.39	53.72	2.66	16.57	15.36	–	–	–	0.30	–	0.95	4.46	100.00
5. Quetta	0.34	3.06	16.39	13.27	11.49	45.59	1.44	2.73	–	0.17	–	0.95	4.57	100.00
6. Loralai	0.47	4.20	18.96	18.63	18.63	32.02	0.32	1.08	–	0.23	–	0.95	4.51	100.00
7. Pishin	0.49	4.45	14.05	17.86	11.92	14.78	5.85	20.45	1.19	0.25	3.25	0.95	4.51	100.00
8. Zhob	0.35	3.23	14.00	11.89	14.62	18.11	0.62	31.50	–	0.17	–	0.95	4.56	100.00
9. Sibi	0.61	5.57	16.18	19.17	17.63	29.80	1.91	3.00	–	0.31	0.42	0.95	4.45	100.00
10. Kachhi	0.30	2.72	43.62	3.08	20.54	23.66	0.39	–	–	0.15	–	0.95	4.59	100.00
11. Nasirabad	0.48	4.33	16.58	16.24	22.82	31.86	1.07	0.92	–	0.24	–	0.95	4.51	100.00

8.12 CONSTRUCTION COST/KILOMETER OF BLACK TOP ROADS IN BALUCHISTAN

(Fig. in Percentage)

PAVEMENT WIDTH 24 FEET

S. No.	Description / District	Reconnaissance, Survey, Design etc.	Land Acquisition.	Earth-Work	Sub-Base	Base-Course	Surfacing	Retaining Walls/ Breast Walls	Culverts (upto 20 feet span)	Longitudinal Drainage	Road Signs	Service Road	Tool and Plants etc.	Contingencies and Work Charged	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Kalat	0.40	3.68	19.36	20.01	22.67	23.34	1.80	3.05	-	0.20	-	0.95	4.54	100.00
2.	Khuzdar	0.33	3.04	13.54	26.84	29.95	17.51	0.66	2.38	-	0.17	0.07	0.94	4.57	100.00
3.	Gwadar	0.35	3.16	19.83	19.05	20.04	27.96	1.06	2.82	-	0.18	-	0.95	4.60	100.00
4.	Punjgur	0.54	4.86	51.39	2.88	17.96	16.65	-	-	-	0.27	-	0.96	4.49	100.00
5.	Quetta	0.21	2.63	14.92	13.68	11.85	47.02	1.24	2.68	-	0.23	-	0.95	4.59	100.00
6.	Loralai	0.40	3.64	17.30	19.27	19.27	33.11	0.27	1.04	-	0.20	-	0.95	4.55	100.00
7.	Pishin	0.44	3.92	13.12	18.90	12.60	15.64	5.15	20.61	1.05	0.22	2.87	0.95	4.53	100.00
8.	Zhob	0.31	2.81	12.88	12.40	15.25	18.88	0.54	31.28	-	0.16	-	0.95	4.54	100.00
9.	Sibi	0.53	4.78	14.71	19.77	18.82	30.73	1.64	2.95	-	0.27	0.36	0.95	4.49	100.00
10.	Kachhi	0.26	2.33	39.62	3.17	24.25	24.35	0.33	-	-	0.13	-	0.95	4.61	100.00
11.	Nasirabad	0.41	3.72	15.11	16.77	23.57	32.90	0.92	0.90	-	0.21	-	0.95	4.54	100.00

9. COST OF MAJOR COMPONENTS OF ROADS CONSTRUCTION IN PUNJAB

(Fig. in Percentage)

	10 Feet		12 Feet		20 Feet		24 Feet	
	High	Low	High	Low	High	Low	High	Low
	1	2	3	4	5	6	7	8
1. Earth Work:	23.36 Khushab	13.77 Bahawalnagar	20.30 Khushab	10.13 Okara	17.60 Rawalpindi	8.08 Okara	16.38 Rawalpindi	7.33 Okara
2. Sub-Base:	20.01 R.Y.Khan	5.67 Rawalpindi	25.88 Faisalabad	8.62 Rawalpindi	31.49 Sheikhupura	10.37 Rawalpindi	28.00 R.Y. Khan	3.73 D.G. Khan
3. Base-Course:	26.01 Bahawalpur	8.09 Islamabad	33.32 Bahawalpur	12.29 Islamabad	36.10 Bahawalpur	15.33 Islamabad	36.96 Bahawalpur	16.41 Islamabad
4. Surfacing:	18.51 Gujranwala	10.81 Lahore	16.92 Gujranwala	10.11 Lahore	19.46 Gujranwala	11.96 Lahore	20.34 Attock	12.57 Lahore
5. Culverts:	21.68 Mianwali	5.01 Vehari	18.24 Chakwal	4.13 Vehari	17.93 Chakwal	3.82 Vehari	19.36 D.G.Khan	3.75 Vehari

9.1 COST OF MAJOR COMPONENTS OF ROADS CONSTRUCTION IN SIND

(Fig. in Percentage)

Description	12' - 0"		20' - 0"		24' - 0"	
	High	Low	High	Low	High	Low
1	2	3	4	5	6	7
1. Earth Work	25.79 Thatta	17.21 Sanghar	21.53 Thatta	13.74 Sanghar	19.86 Karachi	12.46 Sanghar
2. Sub-Base	25.39 Mirpurkhas	12.54 Khairpur	27.95 Mirpurkhas	16.03 Khairpur	28.79 Mirpurkhas	17.30 Khairpur
3. Base-Course	27.35 Mirpurkhas	11.85 Khairpur	30.10 Mirpurkhas	15.15 Khairpur	31.01 Mirpurkhas	16.36 Khairpur
4. Surfacing	17.58 Dadu	11.26 Khairpur	19.97 Karachi	12.65 Mirpurkhas	20.59 Dadu	13.03 Mirpurkhas
5. Culverts	11.46 Badin	2.75 Khairpur	8.11 Badin	2.96 Khairpur	7.99 Badin	3.04 Khairpur

9.2 COST OF MAJOR COMPONENTS OF ROADS CONSTRUCTION IN N.W.F.P.

(Fig. in Percentage)

Description	12' - 0"		20' - 0"		24' - 0"	
	High	Low	High	Low	High	Low
1	2	3	4	5	6	7
1. Earth-Work	41.06 Peshawar	20.18 Chitral	36.32 Peshawar	17.40 Chitral	34.13 Peshawar	16.18 Chitral
2. Sub-Base	14.09 FATA	6.31 Karak	16.60 FATA	7.47 Karak	17.47 FATA	7.94 Karak
3. Base-Course	16.72 Mardan	10.66 Chitral	19.28 Bannu	12.62 Chitral	20.35 Dir	13.29 Chitral
4. Surfacing	26.02 Chitral	2.08 Mardan	30.79 Chitral	16.61 Malakand	32.44 Chitral	17.88 Malakand
5. Culverts	12.42 Karak	3.11 Dir	13.03 Karak	1.48 Manshera	13.19 Karak	1.51 Manshera

9.3 COST OF MAJOR COMPONENTS OF ROADS CONSTRUCTION IN BALUCHISTAN

(Fig. in Percentage)

Description	12' - 0"		20' - 0"		24' - 0"	
	High	Low	High	Low	High	Low
1	2	3	4	5	6	7
1. Earth-Work	58.77 Panjgur	17.09 Pishin	53.72 Panjgur	14.05 Pishin	39.62 Kachhi	12.88 Zhob
2. Sub-Base	23.77 Khuzdar	2.12 Panjgur	26.09 Khuzdar	2.66 Panjgur	26.84 Khuzdar	2.88 Panjgur
3. Base-Course	26.52 Khuzdar	10.41 Quetta	29.11 Khuzdar	11.49 Quetta	29.95 Khuzdar	11.85 Quetta
4. Surfacing	41.31 Quetta	12.24 Panjgur	45.59 Quetta	14.78 Pishin	47.02 Quetta	15.64 Pishin
5. Culverts	20.16 Zhob	0.99 Nasirabad	31.50 Zhob	0.92 Nasirabad	31.28 Zhob	0.90 Nasirabad

10. AVERAGE RATES OF ROADS COMPONENTS PER YEAR IN PAKISTAN

(Fig. in Rupees)

Name of Province	Items of Road	YEARS							
		1980	1981	1982	1983	1984	1985	1986	1987
10' - 0"	Earth Work (000)cft.	226.82	224.81	216.05	243.73	244.14	284.00	214.21	185.99
	Sub-Base (00) cft.	507.43	363.24	503.60	440.33	520.77	502.00	682.79	686.71
	Base-Course (00) cft.	588.97	516.94	672.35	606.39	677.97	655.00	681.53	854.90
	Surfacing (00) sft.	170.95	141.80	161.37	182.16	198.47	343.00	228.47	184.65
12' - 0"	Earth Work (000) cft.	-	308.00	431.00	364.00	435.00	478.00	734.00	538.00
	Sub-Base (00) cft.	-	440.00	467.00	495.00	446.00	521.00	819.00	525.00
	Bose-Course (00) cft.	-	530.00	565.00	642.00	498.00	640.00	516.00	660.00
	Surfacing (00) sft.	-	219.00	272.00	234.00	295.00	275.00	254.00	337.00
20' - 0"	Earth Work (000) cft.	-	312.96	660.54	670.55	1227.00	510.00	586.41	-
	Sub-Base (00) cft.	-	182.23	321.05	220.00	192.00	524.00	254.81	-
	Base-Course (00) cft.	-	428.53	441.94	435.00	738.00	549.00	453.00	-
	Surfacing (00) sft.	-	209.19	267.50	220.37	467.00	934.00	794.24	-
24' - 0"	Earth Work (000) cft.	-	-	-	258.00	-	-	-	-
	Sub-Base (00) cft.	-	-	-	387.93	-	-	-	-
	Base-Course (00) cft.	-	-	-	306.00	-	-	-	-
	Surfacing (00) sft.	-	-	-	134.00	-	-	-	-

11. QUANTITIES USED FOR VARIOUS WIDTH AND THICKNESS OF ROADS - PAKISTAN

(SUB - GRADE) (IN CUBIC FEET)

Formation Width	THICKNESS 6"(0.5)	1'	1½'	2'	2½'	3'	3½'	4'	4½'	5'	5½'	6'	6½'
10'	161,105	32,810	492,150	65,620	82,025	98,430	114,835	131,240	147,645	164,050	180,455	196,860	213,265
12'	19,686	39,372	590,580	78,744	98,430	118,116	137,802	157,488	177,174	196,860	216,546	236,232	255,918
14'	22,967	45,934	689,010	91,868	114,835	137,802	160,769	183,736	206,703	229,670	252,637	275,604	298,571
16'	26,248	52,496	787,440	104,992	131,240	157,488	183,736	209,984	236,232	262,480	288,728	314,976	341,224
18'	29,529	59,058	885,870	118,116	147,645	177,174	206,703	236,232	265,761	295,290	324,819	354,348	383,877
20'	32,810	65,620	984,300	131,240	164,050	196,860	229,670	262,480	295,290	328,100	360,100	393,720	426,530
22'	36,091	72,182	1,082,730	144,364	180,455	216,546	252,637	288,728	324,819	360,910	397,001	433,092	469,183
24'	39,372	78,744	1,118,116	157,488	196,860	236,232	275,604	314,976	354,348	393,720	433,092	472,464	511,836
26'	42,653	85,306	1,279,590	170,612	213,262	255,918	298,571	341,224	383,877	426,530	469,183	511,836	554,489
28'	45,934	91,868	1,378,020	183,726	229,670	275,604	321,538	367,472	413,406	459,340	505,274	551,208	597,142
30'	49,215	98,430	1,476,450	196,807	246,075	295,290	344,505	393,720	442,935	492,180	541,365	590,580	639,795
32'	52,496	104,992	1,574,880	209,984	262,480	314,476	367,472	419,968	472,464	524,960	577,456	629,951	682,448
34'	55,777	111,554	1,673,310	223,108	278,885	334,662	390,439	446,216	501,993	557,770	613,547	669,324	725,101
36'	59,058	118,116	1,771,740	236,232	295,290	354,348	413,406	472,464	531,522	590,580	649,638	708,696	767,754
38'	62,339	124,678	1,870,170	249,356	311,695	374,034	436,373	498,712	561,051	623,390	685,729	748,068	810,407
40'	65,620	131,240	1,968,600	262,480	328,100	393,720	459,340	524,960	590,580	656,200	721,820	787,440	853,060
42'	68,901	137,802	2,067,030	275,604	344,505	413,406	482,307	551,208	620,109	689,010	757,911	826,812	895,713
44'	72,182	144,364	2,165,407	288,728	360,910	433,092	505,274	577,456	649,638	721,820	794,002	866,184	938,366
46'	75,463	150,926	2,263,890	301,852	377,315	452,778	528,241	603,704	679,167	754,630	830,093	905,556	981,019
48'	78,744	157,488	2,362,320	314,976	393,720	471,466	551,208	629,952	708,696	787,440	866,184	944,928	1,023,672

FORMULA USED: (1KM(3281 ft) x Formation Width x Average height of embankment)

12. QUANTITIES OF DIFFERENT ROAD COMPONENTS FOR DIFFERENT THICKNESS AND PAVEMENT WIDTHS

(SUB - BASE AND BASE - COURSE)

(IN CUBIC FEET)

Pavement Width	THICKNESS												
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"
5'	1,368	2,735	4,102	5,469	6,836	8,203	9,570	10,937	12,304	13,671	15,038	16,405	17,772
10'	2,735	5,469	8,203	10,937	13,671	16,405	19,139	21,874	24,608	27,342	30,076	32,810	35,545
12'	3,281	6,562	9,843	13,124	16,405	19,686	22,967	26,248	29,529	32,810	36,091	39,372	42,653
14'	3,828	7,656	11,484	15,312	19,139	22,967	26,795	30,623	34,451	38,279	42,107	45,934	49,762
16'	4,375	8,750	13,124	17,499	21,874	26,248	30,623	34,998	39,372	43,747	48,122	52,496	56,871
18'	4,922	9,843	14,765	19,686	24,608	29,529	34,451	39,372	44,294	49,215	54,137	59,058	63,980
20'	5,469	10,940	16,405	21,874	27,342	32,810	38,279	43,747	49,215	54,684	60,152	65,620	71,089
22'	6,016	12,031	18,046	24,061	30,076	36,091	42,107	48,122	54,137	60,152	66,167	72,182	78,198
24'	6,562	13,124	19,686	26,248	32,810	39,372	45,934	52,496	59,058	65,620	72,182	78,744	85,306
26'	7,109	14,218	21,327	28,436	35,544	42,653	49,762	56,871	63,980	71,089	78,198	85,306	92,415
28'	7,656	15,312	22,967	30,623	38,279	45,934	53,590	61,246	68,901	76,557	84,213	91,868	99,524
30'	8,203	16,405	24,608	32,810	41,013	49,215	57,418	65,620	73,823	82,025	90,228	98,430	106,633
32'	8,750	17,499	26,248	34,998	43,747	52,496	61,246	69,995	78,744	87,494	96,243	104,992	113,742
34'	9,297	18,593	27,889	37,185	46,481	55,777	65,074	74,370	83,666	92,962	102,258	111,554	120,851
36'	9,843	19,686	29,529	39,372	49,215	59,058	68,901	78,744	88,587	98,430	108,273	118,116	127,959

FORMULA USED: (1KM(3281 ft) x Pavement Width x Thickners of Sub-Base or Base-Course)

13. QUANTITIES OF DIFFERENT ROAD COMPONENTS FOR DIFFERENT THICKNESS AND PAVEMENT WIDTHS

(SURFACING)

(In Square Feet)

Pavement Width	(T.S.T.)
5'	16,405
10'	32,810
12'	39,372
14'	45,934
16'	52,496
18'	59,058
20'	65,620
22'	72,182
24'	78,744
26'	85,306
28'	91,868
30'	98,430
32'	104,992
34'	111,554
36'	118,116

The valid rates of different major components of roads may be multiply with these quantities to calculate the cost of these items.

N.B.: The quantities have been calculated with out the provision for curves. 2% to 5% may be added for curves as per requirement of the site.

FORMULA USED: 1KM(3281 ft) x Pavement Width