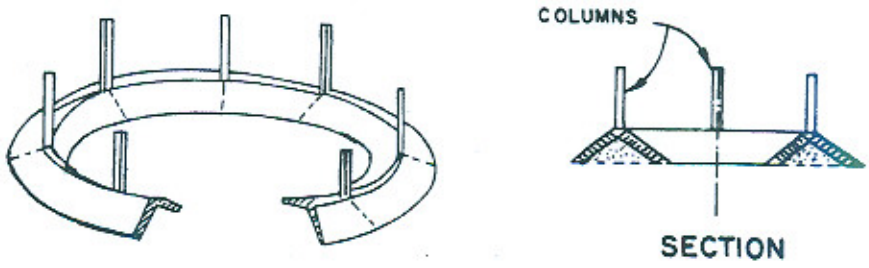
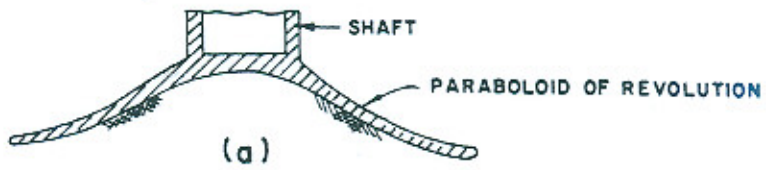


Fig. 10 - FOLDED CONE RING RAFT



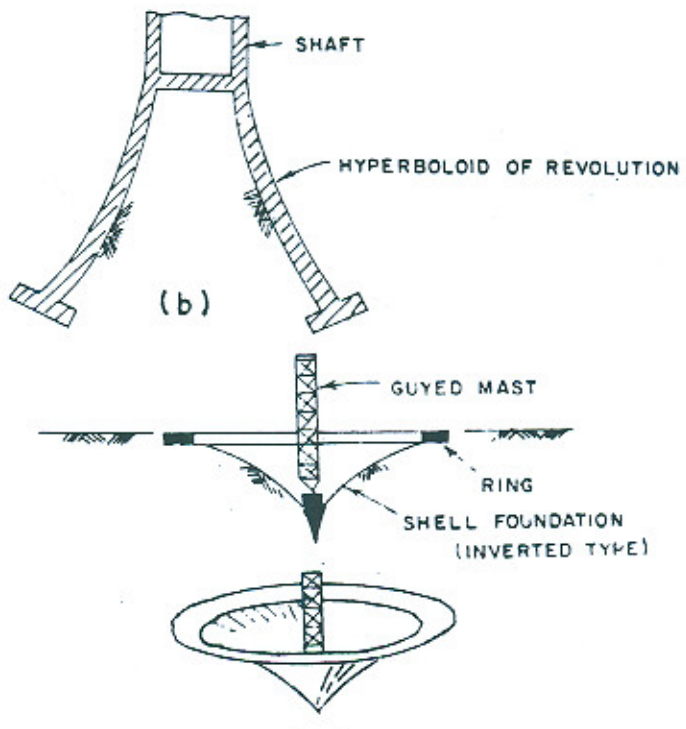


FIG-11 SHELL FOUNDATIONS FOR TOWER-SHAPED STRUCTURES

SCARP PLANNING, OPERATION AND MAINTENANCE

By
*Engr. Nasir Ahmad**

At present about 100 MAF water is diverted annually at Canal Heads from the Indus River and its tributaries for providing Irrigation water to 33 Million acre arable land in the provinces of Punjab, Sind, N.W.F.P. and Baluchistan. Some of these canals are 60–100 years old. No provision was made then for drainage of the Agricultural lands side by side with the construction of the canals. Water logging was noticed adjacent to the main canals and branches after a few years of operation. The vast canals Irrigation system which developed in the Indus plains caused serious water logging and salinity problem. Prior to the introduction of the canal Irrigation system the ground water level depth below the surface in the Rachna, Chaj and Bari Doabs of the Punjab was about 70–100 ft. As a result of the canal Irrigation the ground water table started rising. In some areas water appeared on the surface. The water logged and salinity affected area increased over the years.

2. To tackle the problem of water logging and salinity some surface drainage projects were constructed before Independence and the Rasul Tubewell scheme was initiated in 1947. Under the Rasul scheme 1257 Tubewells of 1.5 cs. capacity were installed along Lower Jhelum an Lower Chenab Canal and their branches during 1947–54 for checking water logging along the canals. These measures were not of much help. According to an estimate about 100,000 acres were going out of cultivation due to the twin menace of water logging and salinity which was badly affecting the Agricultural economy of the country and was a matter of great concern to the Government.

3. A water and Soil Investigation Organization was set up by the Punjab Irrigation Department in early fifties to study the water logging and salinity problem and to provide a scientific basis for the planning of Reclamation Project. The organization was subsequently taken over by WAPDA in 1958. Geohydrological Investigations were carried out by this organization with the assistance of United States Agency for International Development (USAID) in Rachna, Chaj, Bari and Thal Doabs. Information and data on soil salinity, ground water depth and its behaviour and quality was compiled. On its establishment in 1958 WAPDA was assigned the task of combating the water logging and salinity problem. Salinity control and Reclamation Project–I (SCARP–I) was the first Projct which was planned by WAPDA for reclaiming the water–

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logged and salinity affected areas in Central Rechna Doab. Planning and preparation of the Project was done by WAPDA's foreign consultants and the project was executed by Harold.T. Smith an American Contractor in 1959–63. Financial assistance for the Project was provided by USAID.

4. 2069 Tubewells of 2–5 cs. capacity were installed under SCARP–I to cover an area of 1.21 million acres. This project was followed by other SCARP Projects in the Punjab, Sind and N.W.F.P. Provinces. In addition to the construction of SCARP Tubewell Projects the existing surface drains were remodelled and improved and new surface drainage projects were constructed. Tile Drains were also constructed in Sind, and N.W.F.P. The appended Table–1 show the province wise details of Tubewells, Surface Drains and Tile Drains constructed up to June, 1987.

5. The objectives of the SCARP Projects were as follow:–

i) To lower the water table in SCARP area by Tubewells for eliminating waterlogging and improving soil drainability.

ii) To supplement the canal water with Tubewell water and to increase the existing water allowance of 1 cs. per 350 acres to 1 cs. per 150 acres.

iii) To meet the crops consumptive use and leaching requirements of the soil with the additional water from Tubewells.

iv) To increase the annual cropping intensity to 150% of the culturable areas.

v) To provide perennial water supply to non perennial areas and areas previously not supplied with canal water within the projects.

vi) To pump and dispose off the saline and hazardous ground water into drains for depressing the water table.

6. In the schemes it was planned that the Tubewells would deliver water into the existing canal water courses at the Chak outlet. The large capacity Tubewells i.e. 3–5 cs. would deliver Tubewell water to more than one canal outlet chak through link water courses. After a few years of the operation of the Tubewells the water table in the SCARP areas in the Punjab was sufficiently lowered and waterlogging disappeared. The appended tables 2, 3 and 4 show the number of public tubewells installed and area covered in the SCARP Projects in Punjab, Sind and N.W.F.P. Soil Salinity in these areas also improved. The cropping intensity increased to 115–120 percent but 150% intensity as envisaged in the projects was never achieved. However Agricultural production per acre considerably increased in the project areas. The comparison of

the planned, pre-project and the 1981-82 yields of major crops in SCARP-I is given below:-

Yields / Acre in Maunds.

Crop	Planned	Pre Project 1959-60	1981-82
Rice	25	10.05	22.55
Wheat	25	8.66	20.20
Cotton	12	5.15	6.53
Sugarcane	500	263.50	447.80

Though cropping intensities and yields as per targets have not been achieved the SCARP Projects in general have been successful in controlling waterlogging and salinity.

7. The central Monitoring Organization of WAPDA which monitors the performance of SCARPs Tubewells have reported decline in the annual pumpage by the SCARP Tubewells in Punjab. The decrease is attributed to deterioration in the Tubewells discharges. 5-10% Tubewells remain out of order due to electrical and mechanical faults. Specific capacities have decreased due to encrustation of screens. It was envisaged that the Tubewells would last for 20 years. The life span of the Tubewells has actually been much less. Some of the Tubewells failed within 10 years of operation. Due to decline in the pumpage, trend in the water table rise has been observed in the recent years. In about 10% area waterlogging conditions have returned where water table is now at depth between 0-5 ft. In the past years 1700 damaged and deteriorated Tubewells were replaced by WAPDA in various SCARP Projects in Punjab and Sind Provinces. Funds for the replacement were provided by the Federal Government. Further replacement of such Tubewell have been stopped.

8. By 1980 about 10000 public tubewells were constructed in various SCARP projects in Punjab, Sind and N.W.F.P.

After one year of operation by WAPDA the Operation & Maintenance of SCARP Tubewells was given under the control of Provincial Irrigation Departments. In Punjab 4 separate SCARP Circles were created for efficient operation of Tubewell Workshops were also setup for providing repair facilities to the Tubewells. As stated earlier 5-10% of the Tubewells remain out of order on account of mechanical and electrical faults. Repairs are not sometimes attended to promptly as the Tubewells are scattered over a wide area. Each Tubewell is under the charge of a Tubewell Operator. The farmers usually complain about the absence of operators and failures of Tubewells at crucial times. Inadequate provisions of funds said to have affected efficient operation of the Tubewells. The operation and maintenance of Tubewells is

a great burden on Government exchequer. The tubewell water is being supplied to farmers at highly subsidised rate. The operational cost of the tube-wells in Punjab, during the year 1987-88 was Rs: 80.0 crores. Though abiana charged in SCARPS is at double the rate of non SCARP areas the revenue accrued to Government for providing this service was hardly 1/6 of the cost.

9. As per revised policy of the Government it has been decided to stop replacement of the failed Tube-wells in fresh water zone areas of the Punjab. A pilot SCARP Transition Project has been started in Khanqah Dogran SCARP-I to transfer the Tubewells in the area to a farmer or group of farmers or replace the Tube-wells by private Tubewells. This foreign aided Project is estimated to cost Rs. 295.6 million & cover Gross area of 122000 acres. Apart from installation of private tubewells, the lining of small distributaries and minors and improve-ment of Water courses is included in the Project. The high cost of main-tenance of SCARPS Tubewells and the problems faced in efficient operation of public Tubewells due to various reasons have prompted the Govern-ment to initiate privatisation of public tubewells. If the pilot SCARP Transition Project proved a success the Govern-ment may apply the Transition concept to the entire SCARP area of about 4.5 million acres in the Punjab.

10. WAPDA had started the 21 years accelerated programme of waterlogging and salinity control in 1974-75. Under this programme WAPDA planned a four year Reclamation Plan 1986-90 incorporating new policies and strategies for tackling the problem. The total financial out-lay of the plan is Rs. 15 billion. The Reclamation Projects being executed under the plan are given below:-

PUNJAB

Sr. No.	Name of Project	Work Involved	Progress up to June, 1987.
i)	SCARP-VI Panjnad Abbasia (Unit-II-V) CCA 1.27 M.A.	391 drainage Tubewells 1079 Mcft E/Work drains/canals.	55 Tubewells drilled.
ii)	AWL Scheme along TSMB Link CCA 90,000 acres.	76 Tubewells and 40 Mcft. E/work drains.	76 Tubewells Drilled 56 energised.

iii)	SCARP Lower Rechna (Khairwala Unit) SCARP–V, CCA 96,000 Acres.	48 drainage Tubewells 124 miles of surface drains.	48 Tubewells installed and energized 223 M cft. earth work completed.
iv)	SCARP Fordwah Sadiqia Unit–II CCC 154,000 acres.	30 drainage Tubewells 105 miles surface drains.	30 Tubewells drilled and energized 72 m cft E/work done.
v)	SCARP Sukh Beas (CBDC) Phase–I CCC 154,000 acres.	101 drainage Tubewells 83 miles surface drains.	101 Tubewells drilled and energized 7.8 M cft earthwork done.
vi)	SCARP Lower Rechna Faisalabad CCA 160,000 acres.	Construction of 60 Miles new surface drains Rehabilitation of 100 miles drains and tile drains in over 75000 acres.	26 Mcft excavated from surface drains and tile drains in 17,250 acre laid.
vii)	Gojra Khewra Phase–I.	40 drainage Tubewells 30 miles surface drains.	23 Tubewells drilled.

SIND

i)	Left Bank Outfall Drain Stage–I (1.3 million acres).	Construction of 1328 km main branch & sub drains remodelling of existing outfall drains, canals 2249 drainage Tubewells drainage pumps and installation of tile drains.	Work in initial stages of construction.
ii)	North Dadu Surface Drainage (0.514 million acres)	869 km main branch and sub drains. 4 pumping stations.	374 km surface drains stations completed.
iii)	SCARP South Rohri (0.426 million acres)	Construction of 1350 Tubewells, improvement of 680 water courses.	430 Tubewells completed. 293 Tubewells drilled. 419 water courses improved.

iv)	Ghotki Fresh Ground Water Project (0.441 million acres)	1050 Tubewells, improvement of 120 water courses.	410 Tubewells completed & handed over to Irrigation Deptt: 84 water courses completed.
v)	Kotri surface Drainage project Phase– I, Part– II(0.51 million acres).	Construction of 258 miles drain	93 miles Drains Constructed.
vi)	Hairdin Surface Drainage Project (87000 acres).	99 miles drains	58 miles of Drains constructed.
		N.W.F.P.	
i)	Mardan SCARP Remodelling of Surface Drains.	227.2 M cft	55.6 M cft.
ii)	Mardan SCARP Tile Drains		
	Unit– I	24000 Acres.	24000 acres completed
	Unit– II	49000 Acres	11471 acres completed

The left Bank out–fall drain (LBOD) Project in Sind is a gigantic project which aims at the integrated development of Irrigation and drainage in 1.3 million acres (CCA) and provides for construction of an outfall for saline drainage effluent to the Arabian Sea. The Project is expected to be completed in a period of about 8 years at a cost of Rs. 8,594 billion.

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TABLE – I

SCARPS
PROGRESS AT A GLANCE
(PROVINCE–WISE)
UPTO JUNE 1987

	G.C.A. (M.A.)	TUBEWELLS (NOS)	SURFACE DRAINS (KMs)	TILE DRAINS (KMs)
COMPLETED PROJECTS				
PUNJAB	6.66	9,176	1,469	–
SIND	1.99	1,561	2,730	976
NWFP	0.23	491	358	1,290
BALUCHISTAN	0.09	–	171	–
TOTAL:	8.97	11,228	4,728	2,266

TABLE–2

COMPLETED SCARP PROJECTS
PUNJAB

Project	Gross Area Million OC.	T/Wells No.	Period	Installed Capacitycs.
1	2	3	4	5
SCARP–1	1.21	2069	1959–63	6343
SCARP–II	1.61	2205	1963–73	10516
SCARP–III	1.07	1635	1966–73	7163
SCARP–IV	0.56	935	1967–73	4483
TOTAL:	4.45	6844		28505

TABLE–3

MISCELLANEOUS PROJECTS
PUNJAB

	Name of Scheme	Year of Commissioning	No of T/Wells.	Area Covered (Lac Acres).
i.	Shorkot Kamalia	1977	101	0.64
ii.	Satiana Pilot.	1977	71	0.63
iii.	Scarp– III Saline Zone.	1976	61	0.92
iv.	Fordwah Sadiqia (Phase– I Scarp– V)	1977	226	0.73
v.	Panjnad Abbasia (Phase– I Scarp– VI)	1977	623	2.01
vi.	Scarp– II Saline Zone	1977	821	5.53
vii.	T–P Link Tubewells	1978	80	–
viii.	C–J Link Tubewells	1971 – 1975	40	–
ix.	R–Q Link Tubewells	1979	40	0.05
x.	Q–B Link Tubewells	1979	45	0.56
TOTAL:			2105	11.07

TABLE–4

SCARP PROJECTS TUBEWELLS
SIND

PROJECT	T/Wells Installed (No,s)	Gross Area Benefitted
SCARP– Khairpur	540	2.58 Million Acre.
SCARP– North Rohri	1392	In Khairpur, Sukkur, Nawab Shah, Larkana Distt:
SCARP– Sukhar Right Bank	500	
	2432	

SCARP PROJECTS TUBEWELLS
N.W.F.P.

PROJECT	NO. S. of T/Wells	Gross Area Benefitted
SCARP – Peshawar Peshawar City. Kafur Dhert. Pabbi, Jae Sheikh	132	4,06,000 Acre
SCARP – Bannu	176	
SCARP – Mardan	65	

BASE MAPPING
NEED AND USES

By
A.W. Mir

1. INTRODUCTION

Maps are the basic requiremen. for systematic planning and execution of services and facilities in any town of a size. Maps are known to have been produced and used by early Egyptian Civilisations for planning, assessment and Collection of land revenue and of course, for the execution of mammoth civil engineering projects like the pyramids etc.

With the development of civilisation and gradual sophistication acquired by mankind, maps played increasingly vital role in daily life including their usage in warfares.

Surveying and mapping activity on modern lines was introduced in the subcontinent by the British at the turn of the last Century. Initially they had two major reasons for producing maps namely military uses and land revenue collection in the captured territory. Subsequently as they got themselves fully established the need for planning and execution of works required maps. This included major towns infrastructure and irrigation works on the Rivers, cross country canals and water ways, etc.

2. MAPPING ESTABLISHMENT

We inherited our mapping establishment more commonly known as Survey of Pakistan (SOP) from British India days' Survey of India (SOI). SOI of pre-Independence days was very much an offshoot of British Military establishment in India with very strong ties to the Army and Presence of Senior Army Officers in the Department. The same links with the Army are continued in the Post Independence SOP. Large majority of the procedures in the implementation of the rules and regulations governing the publication and issue of maps have remained virtually unchanged. The continuation of being secretive and selective in the disbursement of maps and mapping data in the present age of Remote Sensing is debateable. It will not be out of context to mention here that it does need an urgent review to bring it in line with the present day needs and demands.

The secrecy of maps and surveys was such that;

Alarmed by Napoleon's threat to invade India, the Director (of the Company) sent out a long series of

* Chief (Surveying & Mapping) NESPAK.

orders during 1809 providing for the most rigid control and security of maps and surveys;

-------when such maps or surveys are required by the Governor or Commander-in-Chief, the Surveyor General should attend with them. If they are required to be left, they are to be secured under Lock and Key, and remain in custody of the Secretary to Government, or the Secretary to the Commander-in-Chief, who is to be responsible that no copies or extracts should be made from them; they are to be returned with the least possible delay to the Surveyor General's Office."(1) Inspite of all precautions, it was found in 1820 that many maps were scattered through the various Government Offices in Calcutta, Mostly unknown to the Surveyor General."(2)

Even now restrictions, therefore, tend to be imposed with sledge hammer, not easily deflected by ingenious argument and since the interest of senior public servants lies more in giving advice to ministers than in efficient management (3) the situation has not changed.

3. NEED FOR MAPS

It is axiomatic that maps are an essential basis of effective planning; that they are needed by a variety of private and public undertakings; that for defence they may be vital; and that it is a function of Governments to provide them. A balance has to be struck between what is desirable and what is expedient. To strike the right balance is both difficult and important.

It is an undisputed fact that no matter in what form topographic information is provided to the user printed maps, dyelines, microfilms or digitised data it is the task of the Government to provide it in an uptodate state and in the forms that suits majority of the end users.

The traditional course has been to do 1:1 million mapping first, than 1:250,000, then 1:100,000 and so on, with the disadvantage that each stage the previous work is superseded and in some sense wasted. It would be, however, better to take the bold step and commit to produce maps starting from metropolitan areas at 1:1000 to 1:2500, suburbs at 1:5,000 and rural areas at 1:10,000 to 1:50,000, and so on with the basic scale for remote uninhabited areas at 1:1 million.

4. USES AND SCALES

The increasing demand for information about land by both the public and private sector presents many complex challenges to individuals in mapping sciences and related professions.

Base mapping, particularly of an urban area, can serve many purposes if made available to potential users. Users may range from an engineer who bases multi million Rs. construction designs on the maps, to a local bank

selecting a branch location for new branch, to a development authority considering new urban developemnt or some urban renewal. These users are looking at large scale–maps for different & varying purposes, yet a properly designed and prepared set of maps can serve all equally well.

4.1 HIGHWAY/ROAD &STREET ENGINEERING

For large Cities, a map scale 1:25,000 is convenient for master plan transportation studies; but for small towns, map scales might range from 1:1000 to 1:10,000.

For preliminary location work, a topographic map at 1:2,500 scale with a contour interval of 2 meters is usually adequate. However, for final street design, a scale of 1:1,000 or even 1:500 in heavily urbanized areas and a contour interval of 0.25 to 0.5 are usually required.

All significant ground details and precise location and depth of all underground utilities should be shown on the maps. Since the exact mapping of utilities can be expensive, a practical method for preliminary location is to show all utilities in the area from record information only. Thus the road or street engineer will have the approximate location of all utilities for his preliminary work. Later, when the specific alignment of a particular transportation corridor or a Road interchange has been determined, the horizontal and vertical positions of the utility lines can be surveyed precisely in the limited area to be affected. For some areas the utility record information is precise and no detailed field investigation is needed.

Property maps at 1:5,000 scale for generalized studies and 1:500 scale for more detailed site studies are useful for surveys involving property acquisition for public access, e.g. roads right–of–way.

4.2 WATER SUPPLY

Map requirements of a municipal water–supply agency are generally similar to those of a highway/road engineering department with regard to scale and contour interval. However, depending on the source of water supply, the agency may need map coverage far beyond municipal limits. Some have distant reservoirs and thus need strip maps to construct and maintain pipelines or aquedacts from reservoirs to treatment plants and onward supply to town.

A transparent overlay of population distribution greatly facilitates coordinating water information with growth trends in metropolitan area.

4.3 STORM WATER & SANITARY SEWER ENGINEERING

Map requirement for storm water and sanitary sewer engineering are similar to those for highway/road

engineering; that is topographic map will provide the information vital to a project.

One significant additional factor, however, is that in designing a storm drainage system, a much large watershed area must be considered to make allowance for all runoff that can effect the system. The proper disposal of storm water usually requires downstream terrain information and therefore larger areas of topographic map coverage.

Maps of outlying areas can usually be at a smaller scale than basic municipal maps. For example if city maps are at 1:2,500 scale with 1m contours, adequate runoff information outside the city can normally be obtain from 1:5000 scale maps with 2m contours. In flood-plain areas, 1 to 2m contours on 1:5,000 scale maps may be needed to adequately delineate the flood-plain and their management.

4.4 TRAFFIC ENGINEERING

For generalized studies, area maps at 1:10,000 even 1:25,000 scale may be suitable. Information on traffic flow, accidents, street widths, street corridors, signalization, off street parking, and street widenings throughout a metropolitan are need detailed map coverage at 1:2,500 or 1:1,000 for planning and engineering.

For some problem locations, such as heavily congested intersections unusually large-scale maps at 1:500 or 1:250 scale may be needed. Maps in the traffic engineering category include those for parking surveys, with scale depending on area of coverage. The maps can show off street parking areas, Curb parking, potential parking sites and vacant lands.

4.5 STREET LIGHTING

The map requirements for street lighting are generally similar to those for traffic engineering.

4.6 PLANNING

In a typically urban area, planning is carried out at many levels and by many offices/agencies. Because comprehensive planning requires inter-relating local details with areawide systems, it would be impractical to recommend a single map scale to meet the need of all planners. Regional planners might find 1:10,000 scale maps adequate, whereas an office preparing urban development or renewal might require a maps at a scale as large as 1:500. Generally, however, most planning requirements can be met with basic area coverage at 1:2,500 scale, supplemented by maps reduced or enlarged from the basic maps. For studies where topographly is important, as in engineering improvements and extensive public land projects a topo map with contours at appropriate intervals provide a good base for information.

4.7 TAX ASSESSMENT

These maps may vary widely in scale, age, accuracy, reliability and content. A tax map is highly specialized; its prime feature is the accuracy and completness of property lines. Details normally shown on a large–scale topo map, such as contours, bridges, and street furniture etc., are of little use to tax assessers; but such information as fences, walls buildings, and other details that can aid in the precise location of property lines, are highly important. The location of railways, highways, streets and alleys/ lanes are also necessary in preparing a good tax map.

4.8 UTILITIES LOCATION AND MANAGEMENT

Both municipal & private utility companies or departments are prime users of area wide maps. Large scales comparable to those for street engineering such as 1:500 are requred for mapping utilities.

4.9 CITY SURVEYS

City Municipal Engineers's office benefits greatly from a set of accurate topographic maps The office use the largest scale and smallest contour interval available, but usually base–maps scales and interval suggested for highway/road and street engineering are adequate.

4.10 PARKS & RECREATION

Map requirements for parks and recreational purposes are usually met by a combination of small scale area–wide maps and specific site maps at scales of 1:2,500 to 1:1000 with 1 meter contour interval.

4.11 EMERGENCY SERVICES

Police and fire departments need maps showing all streets and address–numbering systems. The map sheets should be small enough for them to be handled in a confined space, such as a squad car. Depending upon the size of the town/city the workable scale may be 1:2500 or 1:10,000 or 1:5,000. The departments can also use larger scale maps for delination of roof top details, alleyways and other emergency access routes.

4.12 SCHOOL ADMINISTRATION

School administration system, maps to delineate the areas served by various schools, practical busing routes and the precise area served by buses. School administration maps usually tailored to show each school area on a single sheet. Adequate maps can usually be prepared by reducing and compositing the large scale maps under an area–wide mapping system.

4.13 PRIVATE DEVELOPMENTS

As a public services, city maps are often made available at nominal cost to private developers. Because engineers, surveyors, developers and other

professionals are major users of city maps, they should be well informed about the availability of the maps so that they and the general public, in turn, can drive maximum benefit from such a public asset.

5. MAPS UPDATING

A fundamental question in deciding the area for each scale is, how much mapping can we afford and be able to afford to keepupdated. In the rapidly changing environs man made detail will need revision which may need recurring expenditure equivalent to a surprising portion of the cost of the initial mapping.

Adequate budgetory provisions are essential for institutionalising at the provincial level the base mapping of the cities. The procurement of instruments and facilities plus above all adequate and proper training of manpower in the task of updating the mapping.

Maps are an important part of our information – oriented society. To produce a good map is not an easy task by any means, but a new map quickly loses its interest when its represents evolving features. Unless such a map is kept alive through frequent updating it becomes an historical document.

Top quality field data (documentation) is only means of producing top quality maps.

Electronic field data acquisition, processing and CAM (computer aided mapping) technique could economise the updating expenditure plus add the additional factor of increase speed. This is where GIS/LIS introduction is worth evaluating at this stage.

6. DIGITAL MAPPING

The problems of growth and economic expansion faced by city planners and managers today and the corresponding need for rapid access to map data have led the development of digitally integrated cartographic systems. In these systems spatically Oriented data relating to municipal services such as water and gas systems, storm water and sanitary sewer lines, streets and road–way centerlines and boundary lines are keyed to digitized planimetric map data that may be combined into a single composite data base.

The planimetric data can be divided into categories, allowing the recall of separate information types such as roads, streets, drainage, side walks, driveways, fences, building under ground and overhead services.

Because the data are available on an instant–access basis through graphic display, the system provide users with an effective tool for information management. They can access the elements of the data base, display them on a screen in various combinations, or make hard copy. The systems enable users to arrive at decisions quickly and

to provide vital information to the public.

There are other uses and users such as census, civil defence, health work, demographic studies, and zoning.

7. LAND INFORMATION SYSTEM/ GEOGRAPHICAL INFORMATION SYSTEM (LIS/GIS)

LIS, GIS, the multipurpose cadastre– these are the buzzwords of the new computer technology that allows layers of information about land to be stored, manipulated and displayed. Although not new, but the technology is developing at lightening speed.

The promise of these systems has intrigued just about everybody involved in communicating earth's spatial information.

Land information system definition adopted by FIG – Federation International des Geometres and followed by an ad–hoc group of experts who have reported on cadastral surveying and land information systems for the United Nations.

"A land information system is a tool for legal, administrative and economic decision–making and an aid for planning and development which consists, on the one hand, of a data–base containing spatially referenced land–related data for a defined area and, on the other hand, of procedures and techniques for the systematic collection, updating, processing and distribution of the data. The base of a land information system, which also facilitates the linking of data within the system with other land–related data".

Such a definition takes a while to swollow and digest. In the simplest terms it implies that land information system relates to information about land and its attributes. Land may be taken as all areas of the surface of the earth, including those covered by water. Land data is a collection of facts which must be processed into some form that can then be used either for problem identification, for policy decision–making or day–to–day implementation of decisions. The first two of these activities – problem identification and policy formation are of primary concern to geographic information systems where the spatial data is associated with medium or small scale mapping. The systems based on large–scale mapping relate more to policy formation and implementation.([6])

Traditional manual land information systems (LIS) are notorious for problems with information dissemination. It is necessary but difficult to make copies of maps and registers and keep the collected data up- to–date. This is espacially problematic if multiple copies must be updated manually. Computers help overcome these limitations, as they allow one to copy, process, and

disseminate information easily. With the help of electronic data processing, its possible to integerate data collected and stored in different registers and to avoid many of the limitations inherent in slow and expensive manual processes. Integerating data from different sources and making them available to different user groups, a central concept in LIS philosophy is necessary. (7)

Wealth of information topographical, physical (thematic) including utilities above and below ground is split up in layers with specific functions. Each layer could provide some specific services which are then assembled and by next higher layer to provide in turn higher level functions.

Land information systems based on large scale base mapping are emerging in one form or another in many countries and proving most economical.

8. CONCLUSION:

Need for quality base mapping on unified provincial basis was felt for a long time. It is indeed good that Government of Punjab under Punjab Urban Development Project (P.U.D.P) are to carry out base mapping of nine intermediate cities including Lahore and Multan.

Creation of proper institution for handling and updating on regular basis is essential. This leads to requirement of trained man-power and suitable instrumentation for the purpose.

The agency handling the maps should be liberal and not restrictive in their disbursement to the users otherwise the heavy investment will go waste.

Induction of computerised land information system as early as possible is the next logical step to be undertaken.

REFERENCE

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TUBEWELL CONSTRUCTION

By
*Nasir Ahmad**

Tubewells are constructed to utilize ground water for drinking water supply and Irrigation. Another use of tubewells is to lower the water table in salinity affected and water logged agricultural lands. Dewatering is also done by Tube-wells to facilitate civil work construction below ground water level.

2. GROUND WATER INVESTIGATION:

The objective of Ground Water Investigation is to evaluate the ground water resources before any project based on ground water is undertaken. Geologic Investigation by water & soil Investigation Division of WAPDA indicated that the plains of Punjab (Chaj, Rachna and Bari Doabs and Nilibar) are good alluvial acquifers. Except for some areas in the central part of the Doabs the quality of ground water is also satisfactory both for drinking purposes and Irrigation. Tubewells up to 4 cusecs capacity can, therefore, be drilled in these known alluvial acquifers. Since drilling involves heavy expenditure, it is, therefore, advisable to undertake detailed ground water investigations in unknown areas before drilling of tubewells is carried out. The methods and techniques normally adopted in ground water Investigations are:

i) Surface Geological Method.
ii) Aerial Photo Interpretation.
iii) Geophysical Investigations.
iv) Test Drilling.

3. DRILLING EQUIPMENT:

Drilling of Tubewells is carried out with the help of Drilling rigs. The type of Drilling rigs selected for drilling depend largely upon the formation to be drilled through and the size of the borehole. The types of Rigs used are given below.

i) HAND BORING RIGS: Crab winch with derrick, sheave block, bailers and casing pipes. The equipment is worked manually. Suitable for drilling of small dia tubewells in unconsolidated formations i.e. clay, silt and sand.

ii) PERCUSSION RIGS: Drilling is done with bailers on the same principle as in the case of Hand boring. It is trailor mounted rig. Power is provided by a Diesel Engine. The machine is speedier than Hand boring. Suitable for drilling in unconsolidated formations and strata having pebbles and boulders.

* Principal Design Engineer, National Development Consultants, Lahore.

iii) STRAIGHT ROTARY RIGS: used for drilling test holes and for drilling tubewells in semi consolidated and hard formations. No temporary casing pipes are needed.

iv) REVERSE ROTARY RIGS: These rigs are suitable for drilling in alluvial formations. Drill very fast. A tubewell upto 450 ft depth can be drilled in about 36 – 48 hours.

v) DOWN THE HOLE HAMMER DRILLING: Air is used for drilling which operates the drill hammer with a carbide button bits. Used for drilling boreholes in hard formations like Igneous and basalt rocks having fractures and crevices etc.

b) The other equipment needed with Rigs is listed below:

- An air compressor capacity 650 c.f.m. at 250 psi.
- Diesel Generator set – 50 k.w.
- Water tanker 1500 – 2000 gallon capacity
- Water lift pump
- A Truck (5–7 ton capacity)
- Diesel pumping test unit complete with right angle gear drive and clutch arrangements.
- Drill pipes – 500 ft. length for drilling of tubewells up to 500 ft. depth by rotary drilling
- Pipe wrenches, spanners and pipe clamps
- Hoist plugs
- Casing pipes 18", 16", 12" and 10" dia with male and female joint for use with percussion Drilling rigs.
- Bailers, chisels and hammers for percussion Drilling only
- Tricone Rollers bits and Reamers for straight Rotary rigs only
- Clay bits for Reverse Rotary rigs
- Airline 1" dia and Educator pipe 4" dia for tubewell Development.
- D.T.H Hammer with Carbide Button Bits for DTH Drilling

4. DRILLING OPERATION:

During drilling the samples of the strata are carefully collected at every 10 ft interval or at the change of strata. These samples are kept in a sample box. Sieve analysis of the strata is carried out. Sieve analysis curves are plotted. Medium and course sands having high

premeability are good acquifers compared to fine sand. See fig. 1 appended showing typical sieve-analysis curves for water bearing sands and gravels.

5. TUBEWELL SCREENS:

Coir wound, PVC, Brass, fibre glass and stainless steel (wire wound) Screens are used in Tubewell Construction in Pakistan. The strength, durability and cost must be kept in view while making selection of materials i.e. screen and blinds for the design of tubewells.

6. DESIGN:

The well screens must have ample open area and length for having the desired discharge. The Screen length is determined by the following emperical formulae

(1)

$L = 8.5\ Q/pd$

Where L = Total length of the Screen (ft)

Q = Designed discharge of the tubewell (Gmp)

P = Open area of the Screen as % of total area of an equivalent blank pipe

d= diameter of the Screen (Inches)

(2)

$P = 2.65\ a/d = 2.65\ Wln/d$

Where, a = open area in square inches per ft length

W = Width of slot. (inches)

n = No. of slots per foot length

l = Length of slot (inches)

(3)

$l = Q/0.312\ a = Q/0.312\ Wln$

The design standard for the entrance velocity is chosen such that the friction losses in the screen opening will be negligible and the rate of incrustation and corrosion will be minimum. Laboratory tests and field experience have shown that these objectives are achieved if the screen entrance velocity is equal to or less than 0.1 ft per sec. The above formulae are based on entrance velocity of 0.1 ft/Sec. Generally the slot widths are designed to retain 30 to 50 per cent of the formation material depending upon the acquifer conditions. Slot widths of 1mm – 2 mm wide are usually adopted for screens. Wider slot width screens have longer life. Generally 60 ft length of screen of 8" dia pvc or Brass is used for 1 cusec discharge.

7. GRAVEL PACK:

Acts as a filter and provides a sort of course sand which is missing in the formation and permits to have wider screen slots. The gravel must be well

rounded, river borne of sillicions origin and free from calcium carbonate. Well graded gravel pack is designed on the basis of the Sieve analysis of the acquifer formation. Minimum of 3" thickness of gravel pack around the screen is normally provided. Gravel from Campbelpur Quary is generally used in Tubewell construction in Punjab.

8. INSTALLATION OF WELL SCREEN AND BLIND PIPES:

Bentonite is used in drilling with Rotary method. The drilling mud provides lining on the borehole which prevents bore collapse. It seals and prevents water loss during drilling. Before installation of screen/blank pipe in such boreholes it is essential that water should be circulated to clear the borehole of bentonite and clay particles. Centralizers/ centring guides should be used for keeping the screen/ pipe in the centre of the hole for the purpose of having uniform thickness of gravel pack around the screen. A blind pipe of about 6 ft length called bail plug is inserted between the screen and the flat bottom to provide space for sand washed in during operation without decreasing the effective screen length. See Fig. 2 appended showing typical Strainer and Blank casing Bore log.

9. WELL DEVELOPMENT:

After the installation of the screen, blind pipe and gravel pack the development is the removal of silt and fine sand from the formation immediately around the screen thereby increasing the passage ways for the ground water flow to the well and for achieving sand-free water with maximum yield.

Development by surge block, compressed air and incremental pumping (Raw hiding) method is carried out. With Raw hiding method development at 150 – 175% of the designed capacity is done. Development is continued till the well gives sand free water and it is fully developed. Dispersing Agents such as poly-phosphates are also used during development to remove clay or fines sticking in the formation.

10. PUMPING TEST:

On completion of development of the Well pumping Test is performed at constant discharge. The test for draw down and yield is necessary to ascertain the well's capacity. Data such as Pumping rate, pumping level and draw down is recorded. Recovery time is also noted. Discharge – draw down relationship is plotted and specific capacity of the Tubewell is determined. Pumping test is performed usually for 72 hours.

11. SANITARY PROTECTION:

To prevent contamination of the ground water it is essential particularly in the case of Drinking Water Supply Tubewells that sanitary protection to the Tubewell is provided. The Tubewell casing should extend at least 2ft. above the general level of the surrounding land

surface. The pump house should have cement concrete floor and grouting of the annular space around the casing should be done with cement slurry to a minimum depth of 15ft. This prevents the seepage of contaminated surface water down along the outside of the casing.

12. DISINFECTION:

In the case of Drinking Water Supply Tubewells disinfection of the tubewell with chlorine solution is also recommended to kill any bacteria brought into the well during construction.

13. PUMPING EQUIPMENT:

Various types of Pumps used for pumping ground water are given below:-

- Centrifugal Pumps are used where the pumping level is expected to be within 22 ft below the pump centre line. These are cheaper and their maintenance is also in-expensive.

- Verticle Shaft Turbine Pumps are preferred where the ground water level is deeper which does not permit the use of C.F. Pumps. These may be used where the pump setting does not exceed 80 ft. These pumps have been installed in various SCARP Projects in Pakistan.

- Submersible Pumps: These pumps are more economical and practicable where the pump setting exceeds 80 ft. below ground level. Efficiency of pumps varies from one type to another.

a) Metric Horse Power of Turbine and Submersible Pumps is calculated by the formula

$$\text{Metric H P} = \frac{Q\ W\ H}{75 \times \text{Efficiency}}$$

Q = Discharge cubic Metre /Sec.

W = Weight of Water in Kg

= 1000 Kg/m^3

H = Total Head in Metre

b) A simple emperical formula for calculating Horse Power of Motor of a Pump is given below:

$$H.P = \frac{Q \times H}{5}$$

Q = Discharge in cusecs

H = Total lift (Suction Head + Delivery Head in feet).

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o Change of address should be intimated promptly giving old as well as new address along with membership numbers.

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THIRTY SECOND YEAR OF PUBLICATION
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This formula takes into account the efficiency of the Pump and Motor and friction losses of Pipes and Sluice value etc.

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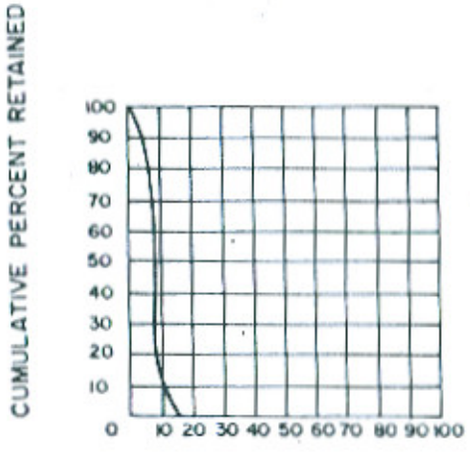
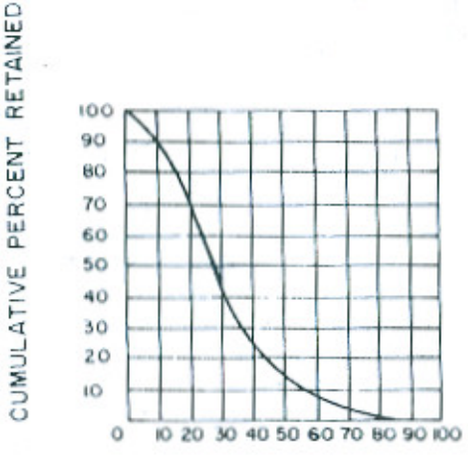
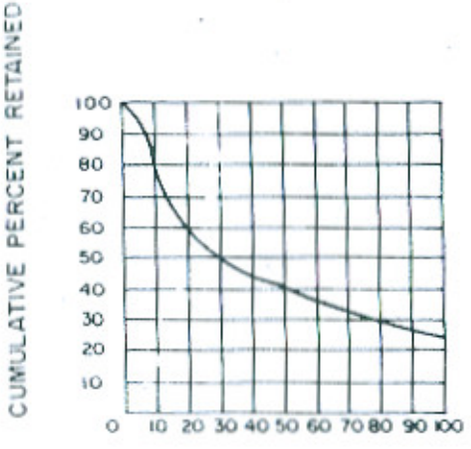
TYPICAL SIEVE-ANALYSIS CURVES FOR WATER-BEARING SANDS AND GRAVELS



A – FINE, UNIFORM SAND THAT YIELDS WATER AT LIMITED RATES.



B – MEDIUM AND COARSE SAND MIXTURE WITH GOOD PERMEABILITY.

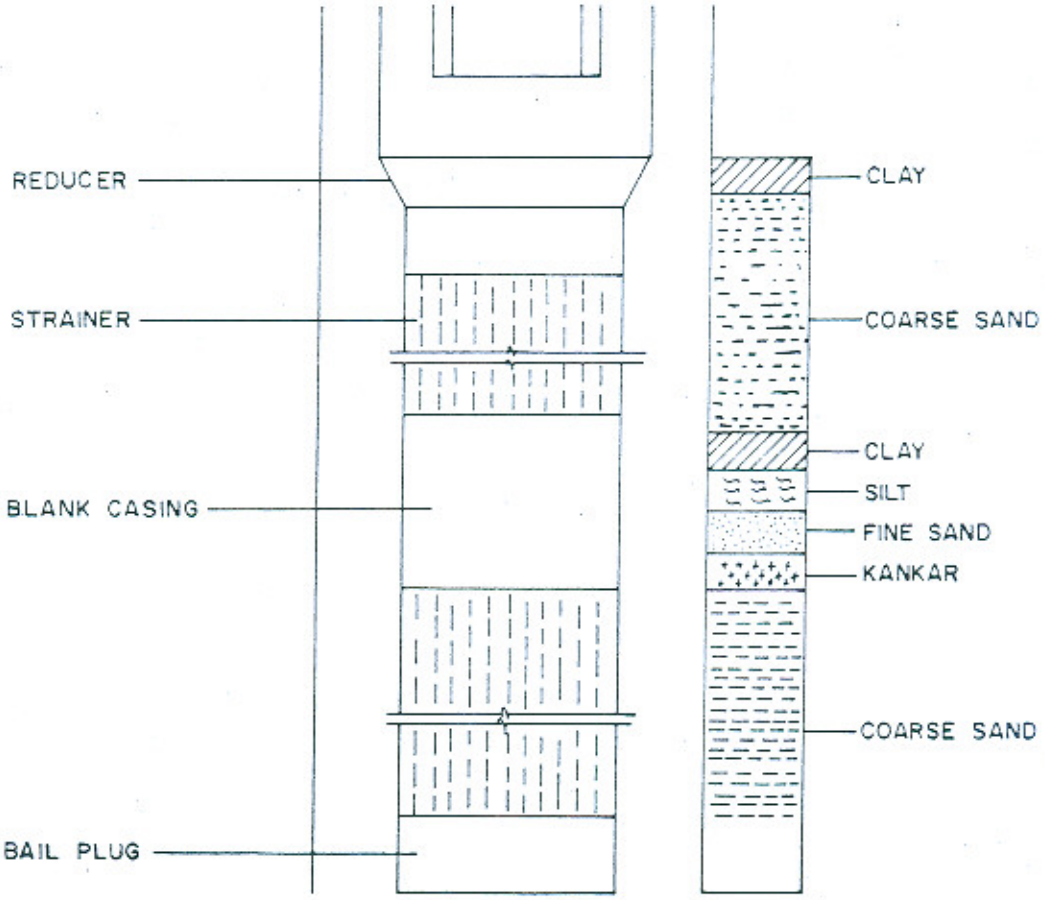


C – SAND AND GRAVEL MIXTURE WITH GOOD PERMEABILITY.

FIGURE-1

FIGURE - 2

STRAINER AND BLANK CASING
BORE LOG



NEWS AND VIEWS

BADR – A, THE FIRST INDIGENOUS SATELLITE

By
Akhtar M. Faruqui

Pakistan's first satellite, BADR–A, will be launched sometime next year.

Designed, engineered, produced and tested by SUPARCO experts, BADR–A – a successful in–house production – will be placed in a 600 km high circular orbit, explained Mr. Salim Mehmud, Chairman, SUPARCO, in a chance meeting in Trieste, Italy. "The satellite is actually ready for launching. We are negotiating with different agencies who can put it in orbit along with a bigger satellite," he added.

A ful–fledged satellite, BADR–A has been designed and developed by SUPARCO engineers and scientists. Its weight approximates 65–70 kg; It will be put into a circular orbit at an altitude of about 600 km and inclination of 95°–98°. The period of the satellite will be about 100 minutes and a pass over Pakistan would last 15–20 minutes. On an average, three to four passes of the satellite are expected in a day.

Four experiments are on board BADR–A, viz (i) a radio tracing beacon which will help to track the satellite from Pakistan and from anywhere else in the world, (ii) monitoring of satellite instrumentation from ground, (iii) tele–command systems (to control satellite operations from the ground), and (iv) a digital communication experiment to store and forward telex messages (just as a travelling mailman would do).

SUPARCO is now working on a communication satellite and a ground receiving station. The space agency is also engaged in high altitude research using rockets which soar as high as 600 km. It has launched 300 rockets so far, and barring the first 10–15 (up to the year 1968), the rest have been manu–factured locally. "Our aim is to go higher and higher – ultimately to be able to place a light weight satellite in near earth orbits," Mr. Salim Mehmud explained.

Currently engaged in temperature–monitoring at extreme altitudes, electron population monitoring, determination of wind speed and direction, SUPARCO plans to multiply the range of its re–search undertakings manifold by initia–ting microgravity experiments and remote sensing in the not too distant future.

Remote sensing, a technique employed for establishing the charac–

teristics of a distant object, is now also facilitated by a satellite – the images obtained delineate the specific features of the object. Remote sensing of the environment and the earth helps conduct 'resource study' aimed at better husbanding of known resources and finding new ones. The satellite images vividly portray the expected trend of snowfall during a year thereby quantifying the water that would flow into the rivers. They also picture the area under forests and establish the rate of deforestation, point to the precise state of the cultivable land, etc.

Studies (employing remote sensing technique) completed by SUPARCO at the behest of sixty national agencies including WAPDA, Geological Survey of Pakistan, Agricultural Research Council, Soil Survey and the Institute of Oceanography, have helped the planners in devising an improved strategy for a better utilisation of available resources, and in discovering new ones.

Till now, SUPARCO has had to bank on ground stations located outside Pakistan for obtaining satellite pictures. The stations were mainly of French/US origin and took about three to six months in supplying the pictures. But as the success of a multi-disciplinary remote sensing application programme is critically dependent upon the availability of real-time/near real-time satellite data on a regular basis, from the operational viewpoint SUPARCO decided to establish a ground station of its own. Thanks to the foresight and the accompanying enterprise, a Satellite Ground Receiving Station, the first in Pakistan, will be commissioned at Islamabad in coming December. SUPARCO will then be able to receive pictures from satellites in real-time, i.e. without delay. The pictures will also be clear than the ones obtained currently from outside stations.

The Satellite Ground Receiving Station (Islamabad) will be one of the most advanced and sophisticated stations for satellite remote sensing data in the Asia-Pacific Region. It will be capable of directly acquiring and pre-processing Landsat MSS and TM data, SPOT HRV data in both multispectral and panchromatic modes and NOAA AVHRR data. Needless to say, the commissioning of the Station would provide an impetus to SUPARCO's remote sensing applications programme and, hopefully, bring it nearer to the ultimate goal of the operational use of real-time/near real-time Landsat, SPOT and NOAA data.

The specifications of the Station had been laid down by SUPARCO experts. It was jointly designed by SUPARCO and foreign consultants. Its establishment thus signifies the development of indigenous expertise and know-how to the level that "for our next station, this work will be done totally in-house. Now we can also act as consultants to other countries. We are already receiving requests from some quarters," Mr. Salim Mehmud said. A welcome news, a heartening one. The outlook for the future seems promising.

Courtesy Dawn Nov. 5, 1988

PAKISTAN'S NATIONAL ENERGY CONSERVATION PROGRAMME

By
Daud Beg, MD, ENERCON,
John Armstrong, GM, Hagler, Bailly

PAKISTAN faces a growing challenge in meeting rapidly increasing energy demands. To date, the country has tried to meet increased demands through traditional means: Increased power generation capacity, oil and gas development, and importation of oil. Although this approach is still very much needed, it nonetheless has not been able to meet fully the country's needs. Substantial load shedding still persists and oil imports currently are at the level of about 80% and are projected to remain at that level.

It is within this context of a serious energy supply/demand imbalance that in 1985 the country turned to energy conservation as a new supply option. A special Working Group on Energy Conservation was convened, and with the help of experts, developed a plan to tap the nation's energy conservation resource. The plan called for a nation-wide programme touching every sector of the economy.

In addition, a comprehensive approach was to be used involving technical assistance, training programmes, information and outreach efforts, development of financial incentives, and the creation of new energy conservation institutions. The centerpiece of the plan was the establishment of the National Energy Conservation Centre, or ENERCON, and a governing council, the Pakistan Energy Conservation Council.

Implementation of the plan was begun immediately. With a grant from USAID, a team of experts was brought on board in early 1986. The Ministry of Planning and Development established new positions and began the hiring process. In December, 1986, Prime Minister Junejo issued a resolution establishing ENERCON as an autonomous body to plan and coordinate the nation's energy conservation programmes.

In a little over two years, ENERCON has made impressive gains in saving the nation energy and money. (See accompanying table of ENERCON accomplishments.) As a result of its

activities, over Rs. 55 million have been directly saved in factories and buildings. For the most part, these savings will continue to accrue year after year. In addition, Rs. 131 million more in savings have been identified as the result of energy audits and are in the process of being implemented. These figures do not include the savings from actions taken by the more than 2,700 technicians and engineers who have attended ENERCON training courses.

The description which follows of ENERCON's programmes and accomplishments is subdivided into the various functional areas of the National Energy Conservation Programme.

1. Institutional Development– ENERCON has been established by resolution of the Prime Minister and is now fully operational. A National Energy Conservation and Management Law has been drafted and is awaiting approval. Four private engineering firms have been trained in every conservation and have been providing services to the private sector for two years.

2. Planning – ENERCON prepared the Energy Conservation Chapter of the Seventh Five Year Plan, setting national targets for energy savings. Detailed work plans have been prepared for all areas of activity.

3. Data Base Development– Computerized data bases have been developed for industry, power, transport and buildings. ENERCON developed the country's first computerized national weather data base and 35 copies have been sold to date.

4. Technical Programme (In addition to items in table).

Industry: Combusion Analyzer/Demo–nstration Programme–26 electronic combustion analyzers have been loaned to plant owners or service firms to demonstrate this technology.

Demonstration Projects– Four demo projects underway:

- Waste heat recovery in kiln of a ceramic plant.
- Installation of economizer in a ghee plant.
- Refurbishing of steam system in tobacco plant.
- Boiler replacement in textile plant.

Buildings: Building Energy Code– drafted and is in approval process.

Preliminary and Detailed Energy Audits–43 PEA's completed: DEA's on Aga Khan Hospital and Secretariat.

Demonstration Projects:

- Five roof insulation techniques on ENERCON building.
- Roof insulation demo on CDA houses.

- Refurbishing of HVAC system on medium-sized commercial building

- Waste heat recovery system on boiler in large hotel.

Computer Simulation-Building energy simulation capability established at ENERCON and schools of architecture.

Agriculture: Tubewell Audit and Retrofit - 100 tubewells in process of being audited: 50 to be retrofitted. Tractor Efficiency Improvement - Tractor energy efficency plan prepared.

Transportation: Auto and Truck Tune-Ups Electronic auto analyzers are being installed in two garages to collect data on efficiency and tune engines.

5. Training and Education (in addition of items in table):

- Completed national energy conservation education needs assessment.

- Received approval from Pakistan Engineering Council for a numbered course on energy management as part of university curriculum.

6. Information and Outreach (in addition to items in table):

- Published 100-page Energy Conservation Equipment Cost Directly.

- Established National Energy Conservation Award Programme.

7. Investment Promotion.

- Completed study on financing and banking practices relative to energy conservation.

- Completed three case studies on energy conservation investments.

- Completed analysis of rates of return for business Investment in Pakistan as compared to energy conservation.

8. Monitoring and Evaluation:

- have established computerized monitoring of all ENERCON programmes.

ENERCOM ACCOMPLISHMENTS

Measured Savings Identified	Rs. 55 million
Energy Savings Identified	Rs. 186 million
Industrial Preliminary Energy Audits	80
Industrial Detailed Energy Audits	42
Average Savings Identified per Plant	22%
Industrial Feasibility Studies	7
Building Preliminary Energy Audits	43
Building Detailed Energy Audits	11
Boiler/Furnace Tune/Ups	250
Average Savings per Boiler	5%

sumed only 1.0% or more of our initial reserves of fossil fuel, we are on the threshold of exhausting them well within the next century if 5% per annum growth rates persists. To sustain 5% growth rate, nuclear, solar and geothermal sources will have to begin absorbing a significant portion of total energy demand before turn of the century and will have to escalate at an ever-increasing rate thereafter.

Regardless of any personal viewpoints, one inescapable fact is that we cannot tolerate a 5% per annum increase in energy consumption regardless of magnitude of energy reserves. We need to decrease our annual growth rate well below 1% before the magnitude of reserves has a substantial impact on their life span. We should become more concerned with the fractional percent increase in energy growth than we presently are. By moving expeditiously toward zero growth in energy, we would simultaneously relieve burdens on all our natural resources and climatic effects.

Pakistan is among those unfortunate countries of the third world where the new gospel of sustainable industrial development through energy conservation has received no more than token adherence from either government or the industrial community. In Pakistan, like all other non-oil rich countries, substantial portion of petroleum crude oil which is used in petroleum refining industry alongwith deficit finished products is imported and will continue to be imported for several years in future as well. Import of crude/finished products petroleum constitute the single largest element in the total import bill.

Awareness of energy conservation at the natioanl level will directly affect the level of crude oil import and consequently the trade deficit and balance of payment. Management of trade deficits is one of the major tasks of the government and energy conservation especially that of petroleum can be a tool for doing so.

What I would like to propose is a eight points programme that I believe would lead us out of the wilderness of energy dependence. It is a programme that I believe all Pakistanis can subscribe to, and one that can be achieved without needless sacrifice on the part of any of our citizens.

1. ENERGY CONSERVATION:

We must have a pragmatic approach to conservation that encourages the wise and efficient use of energy, both by individuals and by institutions. This will permit economic growth, provide jobs, and still enable our citizens to enjoy the standard of living to which they have become accustomed.

2. A CONSOLIDATED ENERGY AGENCY:

My second point proposes to

Average Savings per Furnace	6%
Tubewell Pre-Audit Surveys	315
Electronic Combustion Analyzers on Loan	26
Attendance at 78 one-day workshops	2,500
Attendance at 3 Three-Week Courses	200
Attendance at 3 Home Energy Conservation Seminars	8,200
Fact Sheets available for Industry	28
Total Number of Technical Reports and Studies	123

Courtesy Dawn October 31, 1988

ENERGY CONSERVATION
AN INTERNATIONAL CHALLENGE

By
Dr. M. H. Chaudhry,
Chairman, PERAC

There has been a steady growth in the rate of consumption of energy throughout the world. Based on the statistic, an annual growth rate of 5% /yr. has prevailed for more than a century. This growth rate in energy demand which is exponential can not be ignored as its consequences on energy finite resources is beyond imagination.

An analysis of the potential consequences of prolonged, exponential growth at currently established rates in energy consumption proves this position. Basic data from authoritative sources, used in grossly simplified calculations, shows the results that speak for themselves. A forecast based on simple arithmatical calculation of what would happen if current trends of exponential growth rate is maintained and finite resources of energy is considered, is too frightening.

For example an energy reserve which has a life of 2,000 years in terms of present energy annual consumption will last less than 100 years under an annual growth rate of 5%.Even more startling is the comparison of our so-called, inexhaustible nuclear resources which has been estimated as 5×10^{27} BTU (equivalent to a million years of sunshine).

This resource would presumably satisfy our total energy demand for the world for 20 billion years based on current annual consumption; yet, under 5% per annum growth in demand, nuclear energy wouldn't see us through the next 500 years. Therefore, we should be more concerned with life expectancies for our energy reserves based on exponential growth rather than on present consumption rates.

Although to date we have con-

sumed only 1.0% or more of our initial reserves of fossil fuel, we are on the threshold of exhausting them well within the next century if 5% per annum growth rates persists. To sustain 5% growth rate, nuclear, solar and geothermal sources will have to begin absorbing a significant portion of total energy demand before turn of the century and will have to escalate at an ever-increasing rate thereafter.

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2. A CONSOLIDATED ENERGY AGENCY:

My second point proposes to

consolidate all of the supervisory functions concerning energy exploration, planning, resource development, management and conservation into one governmental agency. For this, we need a comprehensive energy policy, which can control/oversee all the energy related activities in the country. For these reasons, I hope the government will move swiftly to act to formulate this agency in order that energy policy for the country can be developed promptly and efficiently.

3. LONG TERM FORECAST OF ENERGY MIX FOR THE COUNTRY:

Every developed/industrialized country plans and formulates its long term forecast for the energy mix to be consumed over a period of 20 years or more in order to maintain a balance in the consumption and availability of its energy resources. So far, Pakistan has no such programme and because of this reason, there is an imbalance in the consumption and the availability of its energy resources. Little planning and better forecast will be able to reduce the country's import bill for the energy products considerably.

4. DEVELOPMENT OF COAL RESOURCES:

We are now at a point, where we must focus on coal as major energy source. This will involve a requirement that all the newly constructed power generating stations must burn coal, and the older stations, now using oil and gas must be converted into coal.

5. RESEARCH ON ALTERNATE FUEL:

Intensified research on the development of the alternate energy source, e.g. solar and nuclear energy, wind mills etc. is required to be undertaken.

6. ENERGY MANAGEMENT AUDIT OF THE INDUSTRIES:

With the increase in energy cost, it has now become imperative for all Pakistani industries to evaluate their energy efficiency. These must be audited for their energy management, and revamped to maximize energy conservation measures in the system.

7. UPDATING OF PETROLEUM REFINERIES PROCESS SCHEMES:

The existing Karachi refineries (PRL & NRL) are basically primary refineries which produce around 40% (PRL) and 20% (NRL) of their respective crude feed as low price furnace oil.

Since early 70s, when cost of energy shot up manifold, the secondary conversion processes of the residual fuel oil became imperative to increase the distillate fuels energy efficient products yields. Keeping in view all these facts, it is imperative that existing refineries of the country be modernised

by incorporating the secondary process e.g. Hydrocracker scheme in order to extract maximum energy efficient product for each barrel of crude oil. Hydrocracker is a project, which we have proposed to be incorporated in existing NRL processing scheme and are awaiting for Government's go-ahead.

8. EMERGENCY CRUDE OIL STORAGE:

While energy conservation is aimed at our future needs, we must also take action to protect ourselves against any interruptions of current supplies of the crude oil. We must promptly build an emergency crude oil storage supply.

Courtesy Dawn October 31, 1988

THE PUNJAB HIGHWAY AUTHORITY COMES OUT OF NASCENCY

The Punjab Highway Authority was set up in November, 1987 in pursuance of a directive of the Chief Minister to set up a unified and co-ordinated system of motorways and super highways in the Province at par with the International standards.

The job so far entrusted to the Authority consists of the construction of 3 motorways schemes which envisage the construction of a 625 Kms of 4 lane limited access high speed motorways as under:-

1. LAHORE-FAISALABAD MOTORWAY = 100 Kms
2. FAISALABAD-MULTAN MOTORWAY =215 Kms
3. LAHORE-RAWALPINDI MOTORWAY =310 Kms

TOTAL : =625 Kms

These motorway schemes have been provided with Fly overs, Interchanges, Subways & Fencing to ensure safe and uninterrupted traffic flow at a speed of 120 KPH between the major cities of the province. This would also bring about substantial reductions in the accident rate, vehicle operating costs, journey times and distances between cities and would open up new interiors of the province.

The Lahore-Faisalabad Motorway scheme 100 Km is at an advance detailed designing stage with a Swedish Consultants Firm in collaboration with Pakistani firm. It is expected that the construction work would start by the mid February, 1989.

For the other two schemes the preliminary design and feasibility study work has almost been completed and the appointment of the International consultants for the detailed design work are underway.

WAPDA
PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY
IN THE SERVICE OF THE NATION

During the year 1987-88 WAPDA was allocated Rs. 13.774 billion for the execution of various schemes under the Annual Development Programme (ADP) against Rs. 14.117 billion, which was revised Annual Development Programme in 1986-87. The Annual Development Programme . comprised Rs. 10.747 billion for power projects and Rs. 3026 million for water projects. During the financial year 1987-88 WAPDA achieved most of the targets given to it under the Annual Development Programme.

POWER SECTOR

The installed generating capacity increased from 5377 MW at the end of the year 1986-87 to 5577 MW on June 30, 1988 i.e. 200 MW of new generation was added during the year through utilization of latest technology of two "Combined Cycle" units commissioned at Guddu Thermal Power Station. The work on other 13 thermal units was undertaken during the year, as a result of which another 1690 MW will be added to WAPDA's system in the next three years.

The preliminary civil works on Tarbela Hydel Stations 4 units of 432 MW each was also undertaken. A lot of headway was made to induct private sector in the generation of power and at least two Firms were issued Letters of Intent for setting up of thermal power units.

The total generation during the year was 27.29 billion (KWH) comprising 16,69 billion (KWH) from hydel stations and 10.64 billion (KWH) from thermal stations. This was almost 3.7 BILLION (KWH) more than the generation in the preceding financial year, thus recording an increase of 15.7 percent.

A record number of 20.55 billion units were sold (estimated) during the financial year 1987-88 against 17.54 billion units in the preceding year. The revenue collected is estimated at Rs. 18.12 billion which was 33 percent higher than the last year's collection of Rs. 13.68 billion. A record number nearly 5 lakh new connections were given during the year 1987-88 which included as follows:

	1987-88	Total on 30.6.88
1. General (Domestic & Commercial 4,30,530 + 56,738)	4,87,268	54,71,761

2.	Industrial	6,847	1,55,849
3.	Agricultural (Tubewell)	5,719	1,36,860
		4,99,834	57,64,470
	Others (Traction & Bulk)		5,151
			57,69,621

The connections given during the year 1987–88 were over 65,500 more than the connections given in the preceding year.

Besides, 7,443 kilometres of H.T and 5,090 KMs of L.T lines were added to the distribution system in addition to 12,567 distribution transformers of various capacities, ranging between 25 KVA and 200 KVA with a total capacity of 769 MVA to cater the electricity supply needs of the consumers.

VILLAGE ELECTRIFICATION

In the Annaul Development Programme 1987–88 WAPDA was allocated funds for electrification of 1865 villages. However, due to best use of management skills, dedication and hardwork WAPDA was able to electrify 2464 villages from the same funds allocated for 1865 villages, thus 600 villages were electrified without any additional cost to the Government.

TRANSMISSION LINES & GRID STATIONS.

During the last financial year 10 new Grid Stations were commissioned while 50 Grid Stations were augmented/ extended. There are now 540 Grid Stations in Wapda's system with a total transformation capacity of over 18000 MVA. The transformation capacity was increased by over 1000 MVA during the year. Over 12,000 kilometers of high and low transmission lines were erected and commissioned. Work was taken in hand on 500 KV transmission line Tarbela – Lahore – Jamshoro.

WATER SECTOR

The water releases from the reservoirs of Tarbela, Mangla and Chashma during the year 1987–88 were 13.19 million acres feet, comprising 8.16 million from Tarbela, 4.81 million from Mangla and 0.49 million from Chashma.

The total number of deep turbine tubewells put into operation upto 30.06.1988 were 13,160 against 13,160 tubewells installed by the end of the preceding year.

The work on a number of projects like Left Bank Outfall Drain (LBOD), Chashma Right Bank Canal (CRBC) Stage–II, Mardan Scarp, Scarp–IV Faisalabad and Scarps Panjnad–Abbasia continued during the year and satisfactory progress was reported.

PAKISTAN ENGINEERING COUNCIL TAKES COMMENDABLE STRIDES

The Pakistan Engineering Council has so far registered 31,579 professional engineers in different disciplines. Besides, Conduct and Practice of Consulting Engineers Bye-Laws 1986 have been promulgated for the purpose of regulating consulting engineering practice and so far 421, consulting engineers firms have been registered with Pakistan Engineering Council. Moreover in 1987, Construction and Operation of Engg. Works Bye-Laws have been notified for the purpose of ensuring execution of professional engineers thus binding the contractors to employ engineers according to their category for which they have been licenced by PEC. A total of 480 contractors and 9 operators have so far been registered. For the regulation of engineers education certain Bye-Laws have been framed. An Accreditation Committee has been set up to inspect all Universities to ensure minimum standard of education and training. Annual System of examination has been introduced on all Engineering Universities, Colleges to be conducted by external examiners. The qualifications for teaching staff, Professors, Associate Professors, Assistant Professors and Principals of Engineering Colleges have been laid down.

In 1987, Government embarked upon a schemes for providing jobs to un-employed Graduate engineers and asked the Provincial Communication and Works Department to advertise and register such engineers. As a result 4160 engineers were registered upto 30.4.1987 as under:-

Punjab	1327
Sind	1802
NWFP	747
Baluchistan	204
A.J.K.	65
Northern Area	15
Total	4160

It was estimated that out of this total of 4160 engineers, approximately 25% were already employed and were availing opportunity of shifting to other Departments. Thus there were actually about 3120 engineers who were infact un-employed. Apart from normal vacancies, posts in leave/training reserve were created for which funds were provided by Federal Government and 4247 graduate engineers were provided job opportunities upto June 1988 which included un-registered engineers also who had to be appointed in accordance with the Recruitment Rules of Departments concerned. The Finance Minister has announced a fund of Rs. 50 crores for educated un-employed in his budget speech for 1988-89 and the

problem of un-employed engineers would also be taken care of in this fund.

The Government has under its active consideration, amending the Pakistan Engineering Council Act 1976 so as to provide a minimum number of engineers which would have to be employed by the engineering firms. This would result in more job opportunities.

The present Government has taken up the revival of Construction Industry and a Committee comprising the Secretary, Planning and Works, Communication Industries, Water and Power, Chairman, Pakistan Banking Council and three representatives from the Private Sector to suggest short-term and long-term measures for the revival and Development of Construction Industries has been set up. This would provide more incentives to the construction industry and provide more jobs for the engineers.

Government has decided that 30 percent of the expenditure to be incurred on foreign consultancy should be diverted for the employment of local consultancy. This limit of 30 per cent is mandatory on foreign consultants who would be required to engage local consultants.

ACHIEVEMENTS OF PAEC

Pakistan is an energy deficient country both in terms of installed and proven conventional energy resources. Nuclear energy is the only potential option open for Pakistan to cope with this problem. To bridge the gap between demand and supply of electricity Pakistan will have to install a number of nuclear power plants.

Unlike many other countries, Pakistan is faced with certain political snags at international level as regards import of nuclear power plants. In these circumstances it has no way out but to develop indigenous capability to promote its nuclear power generation programme. The Pakistan Atomic Energy Commission (PAEC) has, therefore, chalked out a comprehensive programme to achieve maximum self-reliance in the field of nuclear power generation as its first priority.

The PAEC has successfully mastered the essential technologies relating to uranium exploration, its refining and fuel making for the KANUPP at Karachi. Other relevant nuclear minerals are also being explored, processed and produced by the Commission.

Designing and manufacture of a large number of other nuclear facilities and equipment have been planned to be undertaken by the Commission including nuclear power plants. It is a

sizeable programme and involves considerable financial resources over a considerable span of time.

The PAEC has been operating the Karachi Nuclear Power Plant (KANUPP) since 1976 without any foreign technical assistant or supply of equipment and materials. The Commission has mastered ophisticated front-end nuclear fuel cycle technology and has thus joined the rank of select or so countries in the world who have attained this capability.

The Commission has introduced and promoted concepts of strict tolerance and quality assurance in the national industry. Facilities for preparing special materials and alloys have been developed. As a result of Commission's deliberate and sustained efforts with regard to its own various projects throughout the country, the general standards of mechanical and chemical engineering, manufacturing and project management have significantly improved.

SUPARCO IN PERSPECTIVE

Pakistan Space & Upper Atomosphere Research Committee (SUPARCO) was established in 1961, as the national agency for the promotion of peaceful uses and applications of space science and technology, primarily aimed at the socio-economic uplift of the people of Pakistan. Through the promulgation of Presidential Ordinance No. XX on May 21, 1981, SUPARCO was elevated to the status of a full-fledged Commission. Under this Ordinance, as amended through Act No. II of 15 June 1987, a Space Research Council (SRC) headed by the Prime Minister of Pakistan and an Executive Committee of the Space Research Council (ECSRC) headed by the Federal Minister for Finance has also been constituted. The SRC is the supreme body which directs and controls the space science and technology programmes in Pakistan. The ECSRC oversees the affairs of SUPARCO on behalf of the SRC. It also monitors the progress of SUPARCO, approves the annual budget of SUPARCO and performs such other functions as are delegated to it by the SRC. Besides the Chairman, the Commission has four full time members, viz. Member, Space Research; Member, Space Technology; Member, Space Electronics; and Member, Finance. The principal goals of SUPARCO are:

- to promote peaceful applications of space science and technology, particularly in the areas which are of direct concern to Pakistan;
- to liaise with national and international agencies and organisations in the matters connected with or related to space sciene and space technology; and

to advise the Government of Pakistan on designing of short as well as long term programmes of space science and space technology and assist in devising policies with regard to issues arising out of developments in space science and technology on the international scene.

SUPARCO made its beginning in 1962 with the launching of sounding rockets, the component assemblies of which were imported. Through these launchings, scientific information like temperature, wind profiles, diffusion coefficients etc. were derived in an altitude range of 20–450 km using scientific payloads such as sodium–thermite, grenades, chaff or metallised balloon–borne instrument packages. A large number of these experiments were conducted under bilateral and trilateral international scientific cooperative arrangements with SUPARCO's counterpart foreign agencies: US National Aeronautics and Space Administration (NASA), French Centre National d'Etudes Spatiales (CNES), and the British National Committee of Space Research (BNCSR). The main component of the programme constituted launching of meterological rockets carrying chaff payloads for measurement of wind field in 20–60 km altitude range under International Indian Ocean Expedition Programme supported by the US NASA, who made a long term loan of ground equipment including a tracking radar flight path recording computer and the launcher tube to SUPARCO. The scientific information obtained through sounding rocket launchings was also supplied to the World Data Centre, Boulder, Colorado, USA.

To obviate the need for importing the sounding rockets and their instrumentation, SUPARCO took a policy decision in the 60s to set up its own sounding rocket fabrication plant supported by instrumentation laboratories, the latter to produce the instrumentation necessary for conducting space research. Over a period of some 20 years, SUPARCO has developed facilities for fabricating sounding rockets which can lift scientific payloads weighing some 30–50 kg to heights ranging from under 200 km to 500 km. A broad variety of instrumentation, both for rocket borne and ground based applications, is designed and assembled at the instrumentation laboratories. The rocket launchings are conducted from a launching station located about 50 km north–west of Karachi, which has the distinction of launching the first ever sounding rocket named 'Rehbar–I' from Pakistan on June 7, 1962. As of now, the launching station has different types of equipment to enable assembly of rockets and payloads, their pre–flight testing, launching and post–launching data gathering.

The use of sounding rockets is not proceeding with the same fervour as in the 60s and satellites in varying orbits