Engineering News

A QUARTERLY JOURNAL OF THE PAKISTAN ENGINEERING CONGRESS

July 1999

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COVER PHOTO

Satellite imagery of Larkana area produced by SUPARCO. Major physical features like roads and bunds are visible including parts of Indus. Irrigated land appears as red.

41st YEAR OF PUBLICATION

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ON OTHER PAGES

IN THIS ISSUE

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EDITORIAL

REHABILITATION OF EXISTING ROAD NET WORK

A road is a major capital investment, which is expected to show an adequate return on expenditure. In the absence of proper maintenance or on expiry of its design life, rapid deterioration of the pavement occurs with consequent increase in user's cost and the need for early rehabilitation. Needless to emphasize the significance of the road network that it plays in the socio-economic well being of a country and the vital role it has in national integration.

In our country, where roads are the most vital means of communication, these have not been given due attention and care. The road sector has hardly been getting back one third of its income. Then there has been no enforcement of legal axle weight restriction and the overloaded vehicles are inflicting tremendous damage to the road pavements without any check. In consequence, the road network is fast deteriorating under the growing traffic volume and pressure. It cannot for long withstand the stress and strain of the traffic load, while the dire need to maintain it better and to improve it will brook no delay.

In order, therefore, to avert a state of crisis thereby disrupting the movement of goods and passengers on our roads with disastrous effect on economy, there is a need for reorientation of priorities and for preserving the huge investment by adopting efficient and effective maintenance and rehabilitation of existing road network rather than new construction. It has also been shown that the economic return of rehabilitation is significantly more than the new undertakings in many cases. Funding agencies, therefore, tend to give preference to improving the existing highways.

Before it is too late, we should, therefore, embark upon rehabilitating our worn out network under a crash programme by deferring construction of new roads for a couple of years. This plan can be objectively phased out and priority ranked. Given our resource constraint, private sector may also be invited and motivated to undertake this task by admitting the principle of toll collection.

NEWS

TECHNICAL NEWS

ON TRACK AND ON TIME---COMMUTING WITH GPS

A successful commuter rail service must provide fast, reliable service that rivals the comforts and convenience of a car and West Coast Express knows it. The British Columbia, Canada based company has equipped its locomotives with a GPS-based tracking system that helps ensure customer safety and satisfaction by enabling WCE to monitor its trains, keep passengers informed of delays and better share the tracks with the freight company that owns them.

Not only do WCE commuters travelling from Mission to Vancouver, British Columbia, enjoy spectacular views from a comfortable car, they also rest easy knowing they will arrive on time. They might not know that a GPS-based tracking system is helping WCE consistently adhere to its schedule, but that's just fine with WCE. The company just wants its passengers to know they come first, and if GPS can help guarantee that, then it's a technology worth the investment.

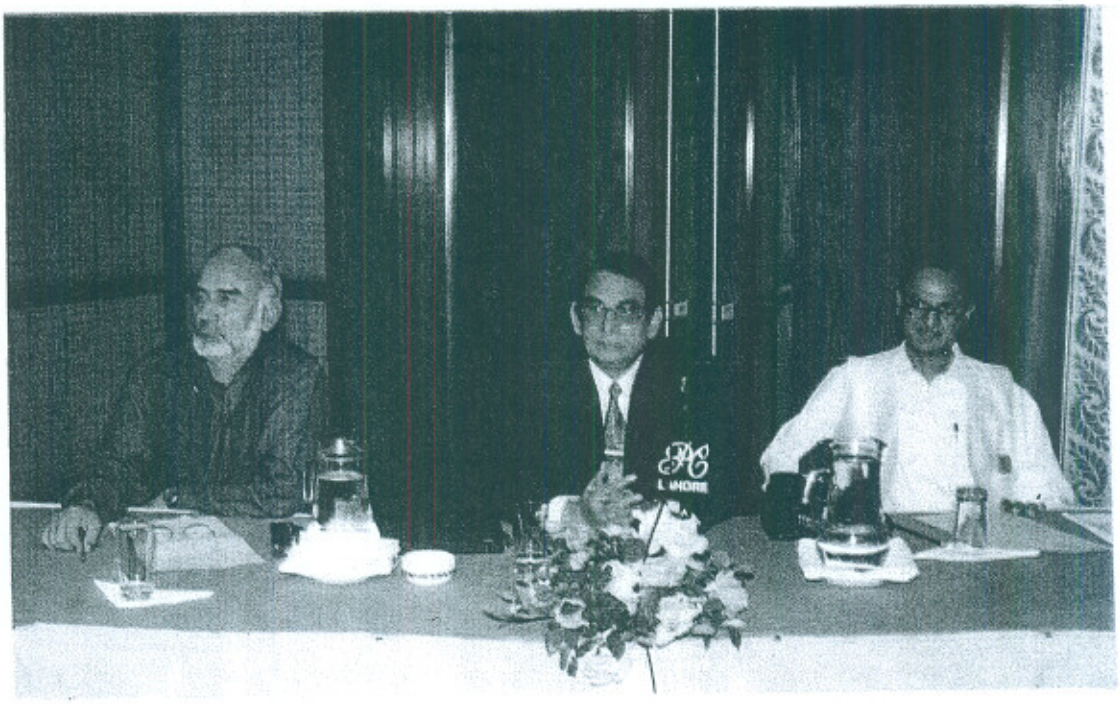
(Source: GPS World.)

RECORD-BREAKING SUPERCOMPUTER UNVEILED

The US Department of Energy (DOE) and Silicon Graphics, Inc(SGI) have unveiled the 'world's fastest computer', The machine-code named Blue Mountain-is located at the DOEs Los Alamos National Laboratory. Blue Mountain is the latest advancement in the Energy Department's stockpile stewardship program which uses science-based methods to assess and certify the safety, security and reliability of nuclear weapons without underground .nuclear testing. Blue Mountain Ran Linpack, one of the computer industry's standard speed tests for big computers, at 1.6 trillion operations per second (teraOps).

At the heart of Blue Mountain are 48 Silicon Graphics Cray Origin 2000TM servers containing a total of 6,144 processors. Blue Mountain is organized into 48, 128-processor hard memory multi-processors, or SMPs. The system is designed so the cluster of 48 SMPs behave like a single computer. These 48 SMPs can communicate with each other at speeds in excess of 650Gb a second.

NEWS IN PICTURES



The President, the Secretary, Pakistan Engineering Congress and the Guest Speaker Engr. Riaz Nazir Tarar on the eve of his Lecture on " World Water Day" held on 22.3.99 at Pearl Continental Hotel, Lahore.

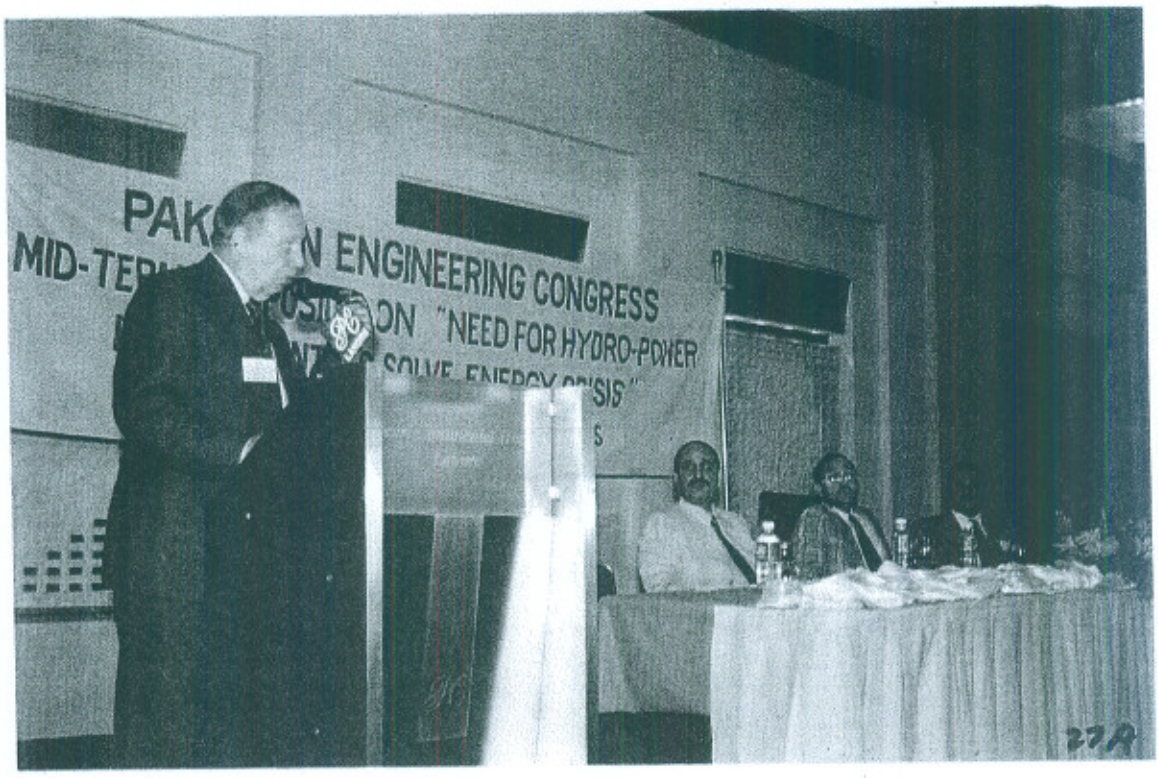
Audience listening the lecture on " World Water Day" held on 22.3.99 at Pearl Continental Hotel, Lahore.

The Federal Minister for Water and Power, Mr. Gohar Ayub Khan, is delivering his inaugural speech during Mid-Term Symposium on "Need for Hydro-power Development to solve Energy Crisis held at Pearl Continental Hotel. Lahore on 22.4.99.

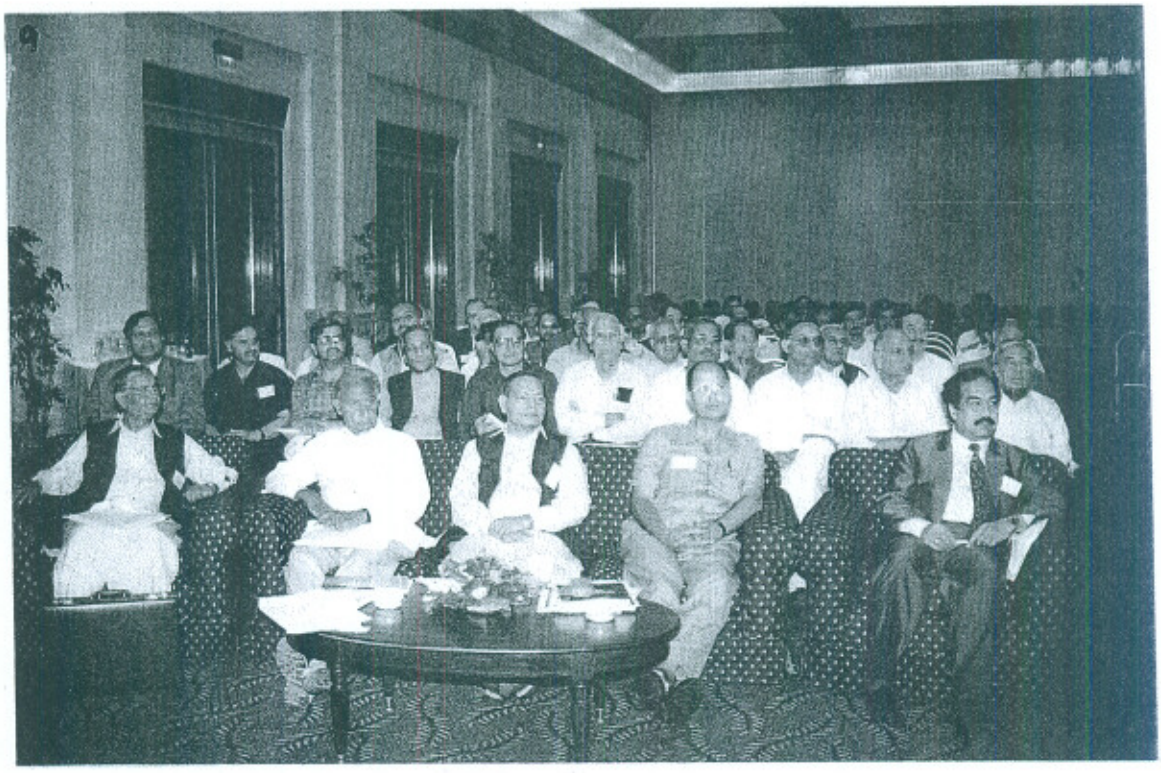
Audience during Mid-Term Symposium on "Need for Hydro-Power Development to Solve Energy Crisis" held at Pearl Continental Hotel, Lahore on 22.4.99.

Engr. S.N.H.Mashhadi, President, Pakistan Engineering Congress is presenting conventional shield to Mr. Gohar Ayub Khan, the Chief Guest, on the occasion of Mid-Term Symposium on "Need for Hydro-power Development to Solve Energy Crisis at Pearl Continental Hotel, Lahore on 22.4.99.

The Chief Guest, Mr. Gohar Ayub Khan, with the audience at Tea Break during Mid-Term Symposium on "Need for Hydro-power Development to Solve Energy Crisis" held at Pearl Continental Hotel, Lahore, on 22.4.99.



One of the Speakers of Mid-Term Symposium is presenting his paper.



Audience during Mid-Term Symposium on "Need for Hydro-power Development to Solve Energy Crisis" held at Pearl Continental Hotel, Lahore on 22.4.99.

WELCOME TO NEW MEMBERS

The Executive Council of the Pakistan Engineering Congress approved membership of the following new members into the Congress fold. The Engineering News congratulates all of them and welcomes to PEC.

Members admitted on 12-01-1999

1. Engr. Khawar Nazir
   XEN, Irrigation, Lahore
2. Engr. Sh. Fazal Karim,
   A.E.E./S.D.O., Irrigation, Faisalabad.
3. Engr. Amer Nasim Khan.
   A.E. LG & RD Deptt. Multan.
4. Engr. Sadaf Kazmi,
   88-D, Gulberg-II, Lahore.
5. Engr. Malik Zahid Ahsan,
   D.E. PTCL, Lahore.
6. Engr. Aamer Sajjad,
   Asstt. D.E. PTCL, Lahore
7. Engr. Amer Shehzad,
   Asstt. D.E. PTCL, Lahore.
8. Engr. Safdar Raza Zaidi,
   Pr. Engr. NDC, Lahore
9. Engr. Zafar Ahmad Khan
   St. Engineer, ACE, Lahore.
10. Engr. Irshad Ahmad,
    A.E. GTPS, WAPDA, Shahdara.
11. Engr. Muhammad Waqar Saeed.
    WAPDA Town, Lahore.
12. Engr. Ejaz Hameed,
    Pr. Engr. NDC, Lahore
13. Engr. Niaz Hassan,
    Chibban, Faisalabad
14. Engr. Noor Ahmed Khan,
    Const. Engineer, M.M. Pakistan,
    Lahore.

Members admitted on 27-02-1999

1. Engr. Anwarul-Haque.
   430-Main Samanabad, Lahore
2. Engr. Muhammad Naeem Akhtar
   380-C, Satellite Town, Bahawalpur
3. Engr. Masroor Haider
   20- Zafar Colony, Samanabad,
   Lahore.
4. Engr. Habib-Ullah Shahzad
   Divisional Eengineer DIG DEV. Gujranwala.
5. Engr. Muhammad Khawar Butt
   103-Allama Iqbal Road.
   Gari Shahu, LHR.
6. Engr. Mazhar Farooq Kaif
   House No. 111, B-1
   M.A Johar Town, Lahore
7. Engr. Asim Ghafoor
   244-A, Ahmad Block,
   New Garden Town, Lahore
8. Engr. Imran Yousaf Janjua
   149-AL-HASSAN,
   Muslim Town More, Lahore
9. Engr. Muhammad Uzair
   15-Jail Road, Shadman, Lahore
10. Engr. Tanvir Hussain.
    B-1, B-2, Ghalib Market Guberg-III, Lahore
11. Engr. Muhammad Abrar Karim
    71-A, Sarwar Shaheed
    Road, Civil Lines, Sheikhupura.
12. Engr. Dr. Akhtar Naeem Khan
    Assistant Professor, UET. Peshawer
13. Engr. Kifayat Shah
    Civil Engineer,
    Khyber Consulting Engineers,
    Peshawar
14. Engr. Asim Aziz
    Structural Engineer,
    Khyber Consulting Engineers,
    Peshawer
15 Engr. Aziz-ul-Hakeem.
    Design Engineer,
    Khyber Consulting Engineers,
    Peshawer.
16. Engr. Muhammad Ameen Sadiq
    SDO-II, Chashma Barrage, Wapda,
    Kundian.
17. Engr. Rauf Altaf
    118-P, Model Town, Extension, Lahore
18. Engr. Muhammad Amir
    E-23/12-M, Nishter Park,
    Walton Road, Lahore Cantt.
19. Engr. Zulfiqar Ali Baluch.
    268-New Samanabad, Lahore.
20. Engr. Izhar-ul-Haq Asi.
    P.O. Chak Himta, Teh. & Distt. Lodhran.
21. Engr. Muhammad Imran
    House No. G-1143, Kucha Haji Peer,
    I/s Yakki Gate, Lahore
22. Engr. Muhammad Arshad
    House No. 1, DHQ Hospital,
    Faisalabad.

BUSINESS RECORDER

The Nation

Friday 23 ... Muharram 1420

support

BUSINESS RECORDER

Tuesday 20 April 1999, 3 Moharram 1420

... on Hydro Power development

... Engineering Congress (PEC) is holding ... Power Development to solve ... Federal Minister for Water ... one-day symposium ... presented by exp... ... by the pa...

MONDAY, APRIL 26, 1999

Need for hydro-power development

Selection of topic and timing are both commendable. The history of the Congress and its achievements narrated by you are really ... sive, rather a source of in... the engineering comm... bers of the Cong... proud of this ... by Gauhar ... for W...

... my late father, Field Marshal Ayub Khan, but allow... government...

INTERNATIONAL THE NEWS

Tuesday, April 20, 1999

Engineers hail launch of Ghauri, Shaheen

Pakistan Engineering (PEC) has hailed the Ghauri and Sha...

... ignore ... pleased and ... memories of the ... progress ... a country ... realised the ... and good efforts ... the engineers are the ... of change and development ... and no country ... achieve prosperity ... their dedication

نوائے وقت

25 اپریل 1999ء

منیر احمد کی وفات قومی سانحہ ہے
سید نذر حسین مشہدی

بقیہ: 46 قومی سانحہ

جنگ

26 اپریل 1999ء

INTERNATIONAL THE NEWS

Friday, April 23, 1999

THE PAKISTAN TIMES LAHORE

پاکستان انجینئرنگ کانگریس

Pakistan can produce 35,000 MW of hydro power

FEBRUARY 25, 1999

European World ... methodology

LAHORE (PPI) – World Bank Specialist on Water Resources Development Projects Engr. Ijaz Ahmed Khan delivered a lecture here on the bank's methodology and system of selection of home and foreign firms of consulting engineers for projects which are financed in Pakistan by the IBRD or Asian Development Bank. The lecture was arranged by the Pakistan Engineering Congress and its President, Engr. SNH Mashahadi, presided over the meeting. It was attended by a large number of engineers and specialists who represented several government departments and Pakistani companies of consulting engineers. In his lecture, Engr. Ijaz Ahmed Khan, discussed at length the World Bank's defined guidelines of short-listing the firms of engineering consultants on different Pakistani projects for which funds are provided by the bank.

... a potential of ... power on main ... MW on ... energy po...

by the engineers would be recognised and nobody would be punished without a proper pro... APP

Daily DIN Lahore

7-4-1999

2010ء میں پاکستان پانی کی کمی کا شکار ...

پاکستان انجینئرنگ کانگریس

Nation

TUESDAY, APRIL 7, 1999

... to set up ... storage

Thursday 4 March 1999, 15 Zi...

... becoming ... vill...

BUSINESS RECORDER

Wednesday 7 Ap...

PEC chi... building

RECORDER REP...

LAHORE: The ...

INTERNATIONAL THE NEWS

Thursday ...

THE DAILY PAKISTAN LAHORE

S.N.H.

DAWN

Lahore, Friday, April 23, 1999

'IPPs issue result o… delaying Kalabagh …n project'

Our Reporter

DIN Lahore

Daily

The Nation

TUESDAY, APRIL 20, 1999

FRIDAY, APRIL 23, 1999

Pakistan has pote… 45,000 MW hyde…

Gohar says hydro-power need of the ho…

LAHORE (APP)–Pa…istan has a po… tential of 35,000 M… …ydel power on main river and another … 000 MW, on side valleys but this va… energy potential is not being develo…ed.

This was the crux of the … mposium on energy crisis in … ian. Gohar Ayub Khan, Feder… …ister for Wa… ter and Power, who was chief gu… the occasion, said that the hydr… development in Pakistan is … need of the day.

Gohar Ayub Khan sai… neers are th… flag bearers … development and no … vance or achieve pr…

PEC hails missiles test

LAHORE (PR… ing Congres… launching missiles of Pa… …kistan Engineer… …s hailed the …d Shaheen … prestige …ions.

…ef calls for more dams

…for an indefinite period. Pakistan had the world's …igation system whic… …ed deserts into ferti… but with the p… …d manifold … …n, there … to dev…

…rson-to-person …ontact via satellite …o possible soo… Correspondent …the recent scientifi… …ill soon become …nd communi… …where and …orld and …come …the

LAHORE: Engineer SNH Mashhadi presenting shield to Federal Minister for Water and Power Gohar Ayub Khan–Staff photo.

…ulty members and students … engineering univ…

THE NEWS

Wednesday

April 7, 1999

Storing flood wat… a must to meet … water shortag…

Engineer Ch M… …rotted tha…

IN MEMORIAM

ENGR. MUNIR AHMED KHAN

Every mortal has to taste the fruit of death sooner or later and Engr. Munir Ahmed Khan was no exception to this law of Nature. He was laid to rest at Lahore, his home town, in the evening of April 25, 1999 after having passed away at Vienna, Austria on April 22, 1999 due to post-heart surgery complications. There are very few who reach the pinnacles of their career and live to see their coveted dreams fulfilled. Engr. Munir Ahmed Khan was one such fortunate celebrity who as the first Chairman of the Pakistan Atomic Energy Commission laid the sound foundations of the atomic technology during his 19 years tenacious tenure from 1972 to 1991 and saw for himself the successful nuclear explosion experiment, one year before he passed away, by the team of Scientists and Engineers groomed under his able guidance. Engr. Munir Ahmed Khan leaves behind a legacy of sincerity of purpose, hard work, diligence and above all love for the country and the people as was manifest from his burning passion to bring Pakistan on the nuclear map when he once lamented 'The Christians have it, the Communists have it, the Budhists have it, but only the Muslims do not have it".

Mr. Khan's vision for Pakistan, and indeed the whole Muslim community, as a centre for science and technology was an inspiration to scientists and colleagues around the world. His dynamism and personal warmth will be surely missed by all colleagues, friends and family who had the privilege of having a share in his life and achievements. His insight into the intricacies of nuclear policy formulation and ability to make Pakistan's voice heard at the international level are needed now more than ever as Pakistan struggles to develop a cohesive nuclear policy in the face of international criticism.

Engr. Munir Khan grew up and received his B.Sc from Government College Lahore as a contemporary of late Noble Laureate Abdus Salam. He later went to the United States on a Full Bright Grant and Rotary International Fellowship where he earned a. Master's degree in electronic engineering from North Carolina State University and an M.Sc. in nuclear engineering from Argonne National Laboratories in Illinois as part of the well-known atoms for peace programme.

Dr. Khan enjoyed a distinguished tenure with the International Atomic Energy Agency(1957.1972). He was one of the first Asian scientists to join the IAEA in the fifties, and rose to become Acting Director of the Reactor Division and Member of the Board of Governors, and was elected Chairman of the Board in 1986-87.

It was while Mr. Khan was still serving with the IAEA that the late Prime Minister, Zulfikar Ali Bhuto,requested him to return to Pakistan as Chairman of the Pakistan Atomic Energy Commission. Under Mr. Khan's dedicated leadership Pakistan's nuclear programme developed into a multifaceted and dynamic centre of science and technology. He established the blueprint and developed the know-how for Pakistan's nuclear capability. This includes the fuel and heavy water fabrication facilities, uranium and plutonium enrichment facilities, Pakistan's indigenous nuclear reactor at Khushab, and the nuclear test facilities at Chaghi.

In addition, the PAEC made formidable strides by developing new strains of rice and cotton that added billions of rupees to Pakistan's agricultural output. Nuclear medical centre across the country have treated hundreds of thousands of cancer patients with the benefits of nuclear medicine. Recently a long-standing dream of Mr. Khan's was achieved with the elevation of PINSTECH nuclear research centre into an internationally recognized university.

As he developed the PAEC programme so too did he grow in international stature as one of the leading nuclear policy-makers to represent the third world interests at international

fora and arenas of negotiation. He was made a fellow of the American Nuclear Society in 1994 in recognition for his promotion of nuclear safety and security standards. His articles and papers on nuclear issues – ranging from technical to political and policy formation have been presented at innumerable conferences around the world. Recently he was made Advisor on Science and Technology at the Islamic Development Bank to assist in developing their investment in the sciences in Muslim countries.

Mr. Khan was endowed with extraordinary skills as a negotiator, whether as Pakistan's representative on the IAEA Board, lobbyist against the discrimination of first world nuclear powers against have-nots, or as a participant in the non-official peace dialogues, in South Asia known as the Neem Rana talks and Shanghai Initiative. It was Mr. Khan's deep conviction that nuclear technology, both in its peaceful applications as well as in its power as a weapon of deterrence, could serve as an incentive to build peace among nations. Although there were those who disagreed with his belief, among them hawks keen to promote an arms race and doves who reject the nuclear option, none could parallel the depth of his understanding of the need to develop a reasoned and appropriate political/policy framework for our nuclear capability.

It was in May 1974 when India exploded its first nuclear device that Mr. Khan's apprehensions and convictions came true. He was in Peshawar to inspect the site for the nuclear agriculture centre there. He had also planned to brief the press about it. He heard the news over the small transistor, which he always carried. A knee-jerk response without deliberation could have won public applause but would not have served the interests of nuclear programme. He cancelled the press conference, avoided talking to the journalists and went to see the Prime Minister in Islamabad and again in Lahore the next day. Two days later he articulated Pakistan's response in carefully worded piece: "Challenge and Response".

He never advertised the Commission's achievements. Some of his own colleagues thought that deliberate policy of low profile was a mistake. They often complained that it had obscured from the public view the Commission's achievements and encouraged some others to hijack what actually had been performed by them. They may have been right but Engr. Khan believed that nuclear technology was highly sophisticated and it required a very high degree of social and political responsibility to handle. Bravado and brandishing nuclear capability would be heighten negative international perceptions about Pakistan, alert the adversary, and make Pakistan's task even more difficult.

He was generous in recognizing the contributions of others. Before his death he confided in close friends that his proposed book "A life in the Atomic Energy" would also recognize and pay tribute to the little known heroes who toiled day and night with him. The Government of Pakistan awarded him **Hilal-e-Imtiaz** in recognition of his dedicated services to the Nation.

He kept a low profile and paid a personal price by remaining unsung. He realised it but it was his conscious decision. In making this decision he was motivated by his sense of patriotism. He is no more with us and the secret no longer secret. Those who know and are still alive owe it to posterity and history to write an true and objective account. He leaves behind a widow, a son and two daughters to mourn.

The Pakistani nation and posterity will ever remain obliged to the benefactions of this great son of the soil.

Acknowledgement

(Courtesy excerpts from DAWN 25th April and the Nation 29th April, 1999.)

LETTERS

To,

Mr. M.I. Khokhar,
Chief Editor Engg. News.

Dear Sir,

I am so glad to see that BRS Lahore is trying to break its long silence by contributing some papers to the Engineering Congress Magazine.. we had seen one in the last issue under caption "Soil mapping of Faisalabad" and the second one now titled "Sulphate Action on Brick Masonry" has appeared in February, 1999 of Engineering News; a pleasant surprise indeed. I can't resist the temptation of commenting on it as my main aim is to try and lift the standard of work and papers of BRS in which I have been actively associated for atleast 12 years. I do not intend to discourage the writers as may be mistakenly thought. In this spirit, let me say the following:

(a) The standard of writing & expression is rather poor despite the fact that the paper is co-authored by a senior scientist and a senior engineer. The most rudimentary description of the commonly known 'efflorescence' on bricks in technical terminology is somewhat amusing. The construction of sentences is a little poor and the text lacks fluency or coherence. It seems that the article has been written for novices, illiterates and non-technical persons.

(b) Brick is not a lattice material (although clay minerals have lattice pattern when viewed though electron-microscope) and neither does it determine the durability of structure. Crucial element in the durability of structure is the roof. Brick is, of course, important element in masonry structures and its strength does play an important role in the strength of walls but the role is a combined one with the mortar. The strength of wall depends not only on the strength of bricks but on the strength of mortar as well. Besides, we have to consider the loads required to be resisted before we design a particular wall.

(c) It is heartening to know that 10 years study was initiated on the effect of sulphate action on brick masonry. If I were to start a study of this nature, I would first collect all the bibliography and document it, then I would go through all the papers and prepare annotations and finally bring out a complete review before starting research work in the laboratory. Incidently if I recall correctly a complete bibliography on efflorescence was compiled in about 1972 which might by unearthed and updated with the help of the internet facility. It is in the review that one brings out the state of present knowledge and identify the gaps for channelizing research. One need not do what has already been done, proved and known. One can't start doing experimental work just because a research facility is available and there is nothing else to do or there is lack of guidance.

(d) The first question is where and how do we get sodium sulphates to the bricks? It is the soluble sulphates that are more harmful as they travel to the surface of brick when masonry is subjected to alternate cycle of wetting & drying and eventually crystallize under favourable atmospheric conditions. Amongst the soluble sulphates, those of magnesium, potassium & sodium are the worst enemies. Calcium Sulphate is generally in-solulde but not wholly. It does not have much destructure effect on bricks but when in solution, it attacks cement of

mortar with vengeance, as it were, and forms calcium sulpho aluminate which expands considerably resulting in crumbling of mortar & disrupting masonry. Does calcium sulphate come from soil underneath or from burnt bricks themselves? If so, what is its concentration? If the concentration is very low, say less 0.05% then they do we have to subject the bricks to 0.1%, 0.2% and 0.3% concentration of sodium sulphates just to prove what is universally known that soluble sulphate salts expand during crystallisation and disrupt the brick or masonry. The writer may be aware that according to German standards, if a brick has upto 0.08% of Na & Mg sulphate, the bricks are deemed to have passed the sulphate test. The soil usually contains CaSo which being mostly insoluble in water is not very harmful. One does not have to perform even the compressive strength tests on brick attacked by sulphates because they would be badly cracked and may have crumbled too.

(e) Although the text states that fig I depicts a pair of bricks joined with mortar joint but the figure I shown at the end is only a graphical representation of what is tabulated in table 1. So we do not know how the samples were placed in a container and what was observed during periodical inspection. May be, no such record was kept and therefore, and easy escape of finding compressive strength was resorted to.

(f) When loss in compressive strength, though irrelevant, had been tabulated, there is no gain in its graphic presentation except to give the paper a scientific look but the diagram does not even give any legend. What is not understood is that the experiment is said to have been performed on two bricks joined together with mortar but the compressive strength has been stated for one brick. How was strength of brick determined when two bricks are said to have been joined by a mortar joint?

(g) The text refers to 2 tables and 3 figs but the paper gives table 1 and fig 1, the later is not even the one described at page 70 of paper. Apparently there is some mess up which is either due to writers blunder or printers devil. However, this is unfortunate. The author should be careful in vetting the printed proof.

(h) My last comment on the paper is that it is not worth the effort that is being put in. Efflorescence tests are already standardised which should have been performed rather than complicating the issue by imposing a layer of mortar which is more suscepatable to sulphate attack than burnt bricks. If the author is really interested on research on this topic, he is advised to get a larger sample of bricks from one kiln and subject them to efflorescence test in several batches. After completion of test, the left over distilled water in the dish be dried to find out weight of salts to which efflorescence appearing on bricks and collected be also added to find out % of salt on the basis of weight of bricks. The salts thus collected be analysed to find out % of various salts. Further work would automatically be channelized on proper lines once % of various salts is known.

(i) Since sulphates attacks cement more than bricks, it would be profitable if some cheap additive is researched for mortars so as to prevent sulphate action on mortars & concrete. Delayed action of sulphate is of no value because of long life of structures. If an additive delays the sulphate action by 3 months or 6 months or a year and even 2 years, we can't suggest that addition for the simple reason that civil structures are built to last 50 or even 100 years. Should such an effort be started, the writer should keep in view that sulphate resisting cement is available in the market which is perhaps cheaper to use. However, the BRS might subject mortars of OPC & sulphate resisting cement to sulphate attack and compressive strength to determine the efficiency of SR cement & its comparison with OPC.

Thank you Mr. Chief Editor. I hope you would be gracious enough to publish this letter in the larger interest of engineering science because I feel that engineering research is not drawing the deserved attention because of lack of proper direction.

Yours faithfully,

(ASHFAQ HASAN)
Engineer Emeritus P&D Deptt, Lhr.

To

The Chief Editor, "Engineering News", P.E.C. Lahore.

Subject: - **Unemployment of Engineers**

(1) At present more than eleven Technical Ministries including key Technical Ministries of Science & Technology, Water & Power, Railways, Communication etc is headed by Non-Engineers, similar conditions are prevailing in the four provinces.

(2) In India Mr: Ajudhia Nath Khosla who was Chief Engineer Punjab Irrigation before Independence was made Governor of Orissa after 1947. There is no such instance in our country although Engineers & Scientists are responsible to produce Ghauri & Shaheen missiles & caused nuclear explosion on 28-5-1998. The nation should have confidence in them & encourage them to post them at the high jobs.

(3) More than 15000 graduate Engineers are unemployed & their number is increasing every year. At present about 85% of the posts in the Federal & Provincial Governments are held by Non-graduates against their quota of 25% . No vacancy has been filled by the Governments for the last 10 years. Federal & Provincial Governments should take immediate steps to fill vacant posts without any further delay & post Technical heads in the Technical Departments besides restoring the quota of Graduate Engineers.

(4) Tarbela & Mangla Dam were constructed as replacement works under Indus Basin Water Treaty of 1960 & no development work has been undertaken for the last 52 years and the population is increasing at the rate of 2.6%. In order to boost agriculture & prevent load shedding, supplying cheaper power & loss of foreign exchange for purchase of fuel oil, work on Indus Dam should be undertaken without any loss of time.

Engr. Khwaja Saleem Ud Din,
Irrigation Engineer,
256-Shadman, Lahore

To,

Engr. Chaudhri Abdus Salam,
C/o Secretary,
Pakistan Engineering Congress, Lahore

Subject:- **Your lecture for PEC**

My dear Abdus Salam,

I was happy that your lecture on "Private Financing of Roads and Bridges – Boot Opportunities in Pakistan?" has provided me an opportunity to contact you after all these years.

I have seen the interesting lecture given by you on the platform of Pakistan Engineering Congress on the above mentioned subject. With my experience on various highways and motorway projects on behalf of National Highway Authority, I would like to comment on your lecture in the following few points.

1. The chances for Boot Projects for roads and bridges are problematic in Pakistan. The model of the Concessions and the most likely possibility is to think in terms of BOT projects and not BOOT projects. The ownership of these projects, specially for roads, bridges and motorways does not belong to the private parties and they are at best given opportunity to Build, Operate and then Transfer the ownership to the public sector, in most of the cases under joint responsibility of the concessionaires and the Government. In most of the cases the subsidy has to be provided by the Government even for advance mobilisation funding support to the private entrepreneur.

2. With the pattern of the traffic and the vehicles in Punjab and NWFP as such with majority of the vehicles as per the ADT are small cars and the percentage of heavy trucks yielding more profitable toll figures is very small. In Sindh the position is attractive for toll financing through the pattern of the traffic being heavier vehicles, exceeding predominantly over small cars. Therefore, the opportunity for private financing of BOT projects in Punjab and NWFP is very remote. Here the successful model is equity participation and sharing the financial investment between Government and the private parties. This has been adopted on Motorway between Lahore and Islamabad M - 2 and Motorway between Islamabad and Peshawar M – 1. On Motorway M – 9 and Northern Bypass in Karachi, the model on these projects can be BOT and through private financing without Government participation for financial support.

3. In the introductory section of your lecture you have mentioned that the funding support has been the motivating factor in various countries for private financed projects for infrastructure in the field of roads and bridges. This is not true, because in France which has set the best example in the world, more than 5,000 kms of motorways have been entrusted to private organisations for financing, management and operation, rather than for funding shortage. In Malaysia also this was the reason to entrust the North-South Highway to a private partly. In USA also the problem is not shortage of funding and financial support by Government which has earmarked billions of dollars under their Transportation Equity Act but to share the additional management and construction facility through the private entrepreneur.

4. I hope, my remarks as above when added as further clarification of your lecture will be beneficial to all concerned.

5. I shall be obliged if you please respond to my notes sent to you through Secretary, Pakistan Engineering Congress, so that I am able to communicate directly with you on your address. Please give me your address as well as telephone numbers for me to contact you.

With my best regards,

Yours sincerely,
ZAFAR & ASSOCIATES
I. A. Zafar

12- Planning for National Objectives-1972.
13- Utilization of Natural Resources in Pakistan for self reliance-1974.
14- Engineers role in Planning, Execution and Management of Projects –1982.
15- Energy Crisis-1986.
16- Quality Control and Materials-1987
17- Hydro-Electric Power in Pakistan-1989..
18- Operation and Maintenance of Completed Projects-1990.
19- Flood Management in Pakistan-1994.
20- International Symposium on Management of Hill Torrents in Pakistan-1995
21- Impact of Power Policies on social and productive sectors-1996.
22- Environmental Project and Resource Conservation-1998.

Honourable Sir, hydro-power is a very important topic of national interest at the present moment. Till recently hydro power although considered more viable, was not considered in terms as clear as today. Hydro-power plants have longer life and are much cheaper as compared to thermal and are also more environment friendly being free from atmospheric or under-ground pollution. The introduction of Independent Power Projects (IPP's) oriented mainly to thermal generation and high cost has made the appreciation of hydro-power more clear.

While discussing faster developments in some others countries people always contend that they have been blessed with oil & gas resources. However, if we seriously think about our perpetually renewable hydro-power resources on Indus Main and its tributaries which are estimated to be about 50,000 M. Watts, we should thank Almighty Allah and make efforts to develop the hydro-power for faster economic growth of the country,. Fossils. power resources are finite while hydro-power resources are infinite.

Sir! we Engineers appreciate the efforts of your Government towards minimizing the ill effects of IPP's and the efforts for increasing hydel-power generation. The issue of improving and enhancing hydel-power production, is under discussion in the relevant professional circles of the Congress membership. The Executive Council of Pakistan Engineering Congress, therefore decided to hold a Symposium on this issue to elicit the opinion and research results from experts in this field.

Sir, this Symposium will be addressed by national and international experts and at the end, the panel discussions will finalize the recommendations for consideration by the Government, the details will be presented by the Convener of the Symposium Committee in his key note address that will follow shortly. We will expect due consideration by the Government under your able guidance.

While concluding this welcome address I thank you and our other distinguished guests for joining us today's proceedings of very high national importance.
Thank you again.
PAKISTAN PAINDA-BAD

INAUGURAL ADDRESS

BY

HONOURABLE GAUHAR AYUB KHAN,

FEDERAL MINISTER FOR WATER AND POWER

Engr. S.N.H. Mashhadi, President Pakistan Engineering Congress, Distinguished Guests, Members of the Congress, Ladies and Gentlemen! Assalam-o-Alaikum!

I am grateful to Pakistan Engineering Congress for inviting me to this very important Symposium and affording me a chance to address this August gathering of Senior Professionals and sharing my own thoughts with you.

Mr. President, your selection of topic and timing are both commendable. The history of the Congress and its achievements narrated by you are really impressive, rather a source of inspiration and the engineering community and members of the Congress can rightly feel proud of this organization. You have quoted Field Martial Muhammad Ayub Khan (God bless him) as saying "No Government worth its name can ignore the Engineers". I am really pleased and feel elated on such vivid memories of the Government and utterances of my late father, Field Martial Muhammad Ayub Khan, but allow me to say that his Government was also the Government of Muslim League which has always upheld the right cause and appreciated good efforts of engineers. Our Government is also a Muslim League Government and you can always be sure of a fair deal.

I agree with you that engineers are the flag bearer of change and development, and no Country can advance or achieve prosperity without dedicated efforts of the engineers.

Your apprehension, that we do not appreciate the engineers is probably based on the ambiguities that prevail in our country.

It is gratifying that the profession is conscious of weeknesses and delinquencies that have crept in a section of the profession and you support the eradicating steps. I, on my part can assure you that good work will be recognized and no-body punished without a proper probe.

The engineers are the back-bone of the progress and economic growth of the Country and the Government realizes it, but any way, you would appreciate that in a society were ethics go on the slide, some-times the corrective actions are prone to appear unduly harsh or pre-emptively punitive. You can however, count me as one of the supporters of the engineering profession.

As I mentioned in the beginning, the subject of this Symposium, i.e. "Need for Hydropower Development in Pakistan" is really an issue of the day. I am glad you selected this topic. I am also pleased to know from your key note address, that the papers to be presented in this symposium have been prepared by the national and international writers who are experts in the subjects and I expect a very high grade of discussions and recommendations. Your recommendations will find my support and attract due consideration of the Government.

In the end I would again compliment the Pakistan Engineering Congress, for arranging this Symposium and providing me an opportunity to talk to you all, this morning.

I now declare this Symposium on **"NEED FOR HYDRO-POWER DEVELOPMENT IN PAKISTAN"** open.

PAKISTAN PAINDA BAD

SYNOPSES OF THE PAPERS PRESENTED

HYDRO-ELECTRIC POWER POTENTIAL IDENTIFIED UNDER PAKISTAN-GERMAN TECHNICAL COOPERATION WITH GTZ ADDITIONAL TO POTENTIAL ON MAIN STEM OF RIVER INDUS

BY
Herbert Kuntz*

Besides the potential on main River Indus, there is also substantial hydropower potential, low-head on barrages and canal-falls and, to much larger extent even, high-head potential on tributaries in northern mountainous areas of Pakistan, including NWFP, N.A. and AJ&K.

GTZ, the German Government Agency for Technical Cooperation, has been active in Pakistan since 1982 to contribute to development of indigenous clean energy resources by training of utility personnel for more efficient operation of power supply systems and to explore possibilities for hydropower development.

In this context, three individual projects of institutional support were arranged for supporting WAPDA Engineering Academy, (WEA), Faisalabad; WAPDA Hydro-Electric Planning Organization, (HEPO), Lahore; and Sarhad Hydel Development Organization (SHYDO), GoNWFP, Peshawar; operating between 1982 and the beginning of 1998.

Within this cooperation period a complete hydropower inventory on low- and high-head hydro potential was carried out, providing evidence for more than 8000 MW of hydropower potential in these areas.

This technical cooperation was evaluated by a German Government evaluation team early 1996 and results achieved by then were highly appreciated.

Following this, both governments concluded an agreement on continuation of this technical cooperation within a Programme for National Hydro-Electric Power Development in Pakistan with the aim that by mid 2002 hydropower potential of Pakistan will be developed in an ongoing, largely self-sustaining process.

Under this Programme, Pakistan Federal Ministry of Water and Power and GTZ have jointly taken up the tasks of

- ✓ coordination and active support of the development of hydroelectric power through the Ministry of Water and Power;
- ✓ preparation of further feasibility studies for the construction of hydroelectric power stations in selected locations;

* Programme Manager of GTZ under Pakistan – German Technical Cooperation for "Programme for National Hydro-Electric Power Development in Pakistan

- ✓ completion of Pakistan's hydroelectric power inventories;
- ✓ preparation of a comprehensive data base, centrally administrated and accessible;
- ✓ further support to the executing organizations necessary for the development of hydroelectric power, at federal and provincial level..
- ✓ Making available the technical know-how to the country's basic and further-training systems, especially at Technical Universities and Academies for further training of engineers.

Further, it is highly recommended to

- ✓ maintain the functioning of WAPDA 's Hydro-Electric Planning Organization (HEPO) as the presently only substantial bearer of hydropower know-how in the country;
- ✓ include hydropower as special subject into educational programmes at Engineering Universities;

both essential to achieve sustainable development of hydropower in Pakistan.

ROLE OF LOW HEAD HYDRO POWER POTENTIAL TO MEET THE ENERGY CRISIS IN PAKISTAN

By

Engr. Mahmood Ahmad Malhi *& Engr. Muhammad Farooq Ahmad**

Low head potential in Pakistan means, the potential available at barrages and canal falls in the plains of Punjab Sind, NWFP and Balochistan.

Pakistan's river system is dominated by the Indus River. The principal tributaries of Indus river within Pakistan are Shyok, Shigar, Gilgit, Kabul, Swat, Kurram and Gomal on the right side and Siran, Haro, Soan, Jhelum, Chenab, Ravi, Beas and Satluj on the left side.

The economy of Pakistan is entirely agricultural. About 75% of the country's population live in Indus plain in the province of Punjab and Sind. Pakistan rightly claims to own the largest irrigation system of the world. The whole irrigation system consists of 8 dams, 15 barrages, 6 headworks and 72 canals. Most of the barrages and canals exist in the Provinces of Punjab and Sind. Canals were provided with fall structures for bed stabilization and water diversion. During construction of irrigation system the development of hydropower potential along barrages and canals could not be taken up due to financial constraints. Only few power stations were constructed.

Low head hydropower development is the pioneer and the oldest one, in generating electrical energy than other types such as thermal, medium and high head hydels in Pakistan. It actually started in the Punjab province in 1925, by utilizing a fall of 3 m on Lower Bari Doab Canal off-taking from Balloki Headwork on Ravi River. This project is known by the name of Renala Hydel Station. In 1938 Malakand-1, a medium head plant was constructed in the North-West Frontier Province (NWFP) with a capacity of 7 MW on Swat River. Later, it was upgraded

* Chief Engineer, HEPO, WAPDA Sunny View Estate, Lahore.
** Deputy Director, Hepo WAPDA, low Head Cell Gulberg, Lahore.

to 20 MW. In 1954, an other hydel power station named Dargai having a capacity of 20 MW was constructed on the same canal. Then there was 5 Hydropower plants constructed in the coming years. Thereafter, the development of low head hydropower projects within the irrigation system was ceased due to unknown reasons, whilst the development of large dams started in 1962 (Warsak Dam). Soon after, construction of Mangla and Tarbela Dam projects was started.

Recently after a very long break the construction of Chashma hydropower project has been started at Chashma Barrage.

In early eighties, it was realized that large hydel projects have long gestation period and take quite sometime for implementation. Therefore, ranking study for "Low Head Hydro Power at Barrages and Canal Falls" along existing barrages and canal falls were taken up and completed in 1984 by WAPDA-HEPO in collaboration with German Agency for Technical Cooperation (GTZ). About 10 sites were studied under ranking study. To ameliorate the energy situation, about 9 number of projects have been studied up to feasibility level in Public and private sectors so that construction could be taken up at any time. A total power of 360 MW could be exploited from these 9 sites.

In early 1990s, a comprehensive inventory of the available hydel potential at existing canal falls and barrages along the irrigation system was undertaken. Thirteen barrages out of 22 were studied in detail. The remaining can not be studied due to limited available data. The total installed capacity could be in the range of 35 to 175 MW. The inventory of canal falls (perennial and non-perennial canals) comprises a total of 586 sites. The head available at these falls varies between 0.03 to 13.83 m. Most of them have head less or equal to 1.0 m. The power potential at each canal falls was evaluated. Gross power potential available is about 550 MW. Individual canal falls and combination of 2 or more falls were studied to have capacity of 5 MW and above. For combination of falls maximum distance of 100 RD was taken as limit. A total of about 180 MW could be exploited.

Low head potential has some merits such as, short gestation period, availability of infrastructure, closeness to the load centers, required civil works are fully or at least partially developed, less capital intensive, no hydrological risk, attractive to Private sector, no socio-economics or environmental risk, less technological risk and less construction completion risk. Therefore it is recommended to construct other planned projects such as Jinnah, Taunsa, C.J. Link Tail, New Bong Escape, B.S. Link, D.G. Khan Link and Guddu for which feasibility reports are ready. Other exploitable potential from inventory may be assessed properly, which can play a remarkable roll in the development of the country under private power policy. It should be kept in mind that in the development of new low head hydropower, greater difficulties than in the past are expected because, best sites are already used. Electrical energy generated by low head plants may be expensive in general as compared to high head plants; however, the low head plants less than 20 MW may provide low tariff, if there connection with grid (at different voltage level) is considered.

AVAILABLE DATA BANKS AND INFORMATION ON HYDRO-POWER

BY
Dr. J.J. Victoria*

In connection with the quantification of the available hydro-power resources of Pakistan, a considerable amount of information has been compiled, processed and synthesized.

With regard to Hydrology and Sedimentation, a comprehensive computerized data bank has been developed for the main rivers and tributaries in the north of the country (NWFP), AJK and Northern Areas) and Balochistan. The data bank, which is jointly being developed by WAPDA, SHYDO and GTZ, contains modules for processing and sysnthesis of the data. It comprises all the hydro-logic data recorded and published in Pakistan since the year 1960. Presently, the data bank contains information of 120 hydro-logic stations. The parameters include water levels, stream flow measurements, suspended sediment load, bed load and water quality.

Concerning topography, available GT sheets on scales 1:250.000 and 1:50,000 constitute the initial source of topographic information to carry out any investigation. However, the level of detail in these maps (contours every 20 to 40 meters) is not sufficient to evaluate the projects. Quick assessment of levels and heads can be achieved with help of high precision altimeters, although the horizontal distances must be determined using other methods. Global Positioning System (GPS) allows a very accurate determination of 3-dimensional coordinates. It has been adopted to establish base lines for conventional topographic surveys and also to develop a basic surveying network along Indus River and its main tributaries upstream of Tarbela reservoir.

With respect to seismicity, originally, telemetric data of various catalogs (American, Russian and Chinese) was obtained from NOAA (USA). The data relevant to Pakistan was selected by defining a window extending beyond the borders. Important seismic sources, such as Hindukush have been included. Nowadays, the information of the telemetric network can be obtained though the Internet, allowing to keep updated information. In order to derive the required design parameters, the data bank includes computer software to scan and process the seismic events for the areas of interest.

All the socioeconomic data collected as part of the power market studies and demand forecasting has been systematically stored on magnetic media. Some of this information, especially with regard to population, will be updated when the results of the census in 1998 are available.

With help of GPS and satellite imagery, a Geographic Information System (GIS) is presently being developed for the Indus River valley upstream of Tarbela. The aim is to have an integrated system, which will allow an objective and reliable assessment of the implications of the any project proposed on Indus River and its main tributaries.

Extensive documentation is available about the inventories of hydro-power potential carried out in the country including low-head projects in the Indus plains as well as medium-and high-head projects at higher elevations.

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* Head of GTZ Civil Engineering Section under Pakistan-German Technical cooperation for "Programme for National Hydro-Electric Power Development in Pakistan"

Guidelines have been developed and regularly applied for works in hand. Additionally, training material has been developed in various relevant topics and used at WAPDA Engineering Academy and CEWRE/UET.

FACILITATION OF HYDRO-POWER DEVELOPMENT BY INDEPENDENT POWER PRODUCERS

BY
Engr. Riaz Nazir Tarar*

It is intention of the Government to create a competitive power market by restructuring / privatizing the existing public sector utilities of WAPDA and KESC. This is proposed to be achieved through the autonomous National Electric Power Regulatory Authority (NEPRA) established in December 1997 through an Act passed by the Parliament. NEPRA will be solely responsible for over-seeing of power sector through licensing for generating, transmission and distribution.

While transformation of power sector into a privatized / competitive industry will evolve over time, in the in-term period it would be necessary to create an environment of facilitating the efforts of independent power producers (IPP's) towards this end and particularly through development of the indigenous hydro-power resource.

The paper examines this issue in the context of : NEPRA's role in the light of latest (July 1998) Government Policy for IPP's; present status of hydro-power including developable potential and imperatives of national development; and need for facilitation of efforts by IPP's to elicit their active participation in development of the renewable national resource of hydro-power.

NEPRA has already taken an initiative through launching of a study to facilitate the matter. The study aims at proving to the interested IPP's the relevant information in the form of :-hydro-logic data of potential sites: review / evaluation of the existing information and data; evolution of a rational ranking criteria; re-ranking of already identified / engineered projects; and recommend a priority list of the projects which could be offered to IPP's. In order to standardize further hydro-power development by IPP's as well as their uniform scrutiny by various public sector agencies, the study would also provide guidelines regarding : report formats ./ contents of pre-feasibility level studies; requirements of details / design for bankable projects and tender documents/specifications competitive bidding.

* Senior Consultant, National Electric Power Regulatory Authority (NEPRA), Islamabad

FEASIBILITY STUDIES READY FOR INVOLVEMENT OF PRIVATE INVESTMENT UNDER 1998 POWER POLICY

BY
Engr. G.M. Ilias* & Engr. Javed Rashid**

Inventory studies in the northern mountainous areas of Pakistan including NWFP, Northern Areas as well as on barrages and canal-falls in the irrigation systems of low-lying areas of the country have revealed hydro-power potential at more than one hundred individual sites.

So far 13 feasibility studies have been prepared in the public sector and are being offered to the private sector for setting up power plants. A number of projects were initiated by the government of NWFP and Letters of Support (LOS) were issued under the Government of Pakistan Policy Frame-work of 1994-95. However, no concrete results were achieved. Only three of these projects stands allocated to private investors but their fate is unknown.

The Government of Pakistan has reviewed the whole issue of private Power Policy and finally issued the Revised Policy for New Private Independent Power Projects in July 1998. This policy is much more favourable for hydro-power projects than the previous one. It provides a tariff structures more adequate for hydro-power and ensures more transparent procedures. The policy stipulates further that the project sites should be offered for IPP's preferably on the basis of feasibility studies prepared in the public sector.

There are five projects available in NWFP for early issuance of Request for Proposals (RFP) to invite investors under International Competitive Bidding (ICB) for implementation as their feasibility studies are readily available.

The locations are:

1. Khan Khwar near Besham, Swat District ..... 72 MW
2. Golen near Kaghozi, Chitral District..... 100 MW
3. Dara Khwar near Bahrain, Swat District ..... 35 MW
4. Summar Gah upstream of Dassu, Kohistan District..... 28 MW
5. Batal Khwar near Utror, Swat District ..... 8 MW

An integrated transmission study has been carried out to transport the energy into the National Grid whilst costs are to be borne by the respective projects.

Presently preparations are being undertaken by Government of NWFP in collaboration with the federal Government Institutions Like PPIB and NEPRA to attract investment for these projects.

As the lead time for hydel plants is relatively longer, it is strongly recommended that work on their implementation be started immediately to ensure their commissioning by 2005-2006. By that time, the surplus thermal power is expected to be fully utilized to meet the demand of the coming years.

* Consultant to GTZ under Pakistan German Technical Cooperation for "Programme for National Hydro-Electric Power Development in Pakistan".
** Engineering Economist to GTZ under Pakistan-German Technicl Cooperation for "Programme for National Hydro-Electric Power Development in Pakistan".

DEVELOPMENT OF HYDRO-POWER TO MEET ENERGY CRISIS OF THE COUNTRY

BY

Engr. Ghulam Abbass* & Engr. Fayyaz Asghar**

ENERGY CRISIS

Pakistan despite being endowed with large indigenous hydro-power resources, has recently suffered a rapid switch over to expensive thermal power development which has caused a significant rise in tariff for consumers. The scenario of power generation was 60:40 hydel thermal in 1960 which has gone to 32:68 in 1997 due to the delay in commencement of ready hydro-power projects (Kalabagh/Basha) and further delay on next projects in the pipeline. The economy of the country had to suffer not only in energy sector but also significantly in agriculture and industrial sector.

The energy demand has an inclining trend and the power shortfall will keep on accumulating causing future energy crisis in the country. It is expected that the peak power demand in 2018 will be 46681 MW. It will result in shortage of 31625 MW required to be met through either hydel or expensive thermal development.

HYDRO-POWER POTENTIAL

Pakistan located in an area blessed with abundant natural resources. The northern parts of Pakistan are the source of enormous runoff draining to number of streams and rivers conducive for hydro-power development. Only the River Indus has an identified hydro-power potential of about 30,000 MW, whereas total indentified potential in the country is about 36,000 MW, out of which only 4825 MW has been developed so far.

DEVELOPMENT STRATEGY IN PUBLIC SECTOR

WAPDA since its inception is contributing for identification, preparation of engineering documents and implementation of hydro-power projects to keep abreast with the forecasted demands. The projects privatized for implementation were however delayed in commencement.

Government of Pakistan, presently is giving priority for indigenous resource development including hydro-power to account for the future energy short fall due to increasing power demand. In this regard two major projects namely Ghazi Barotha and Chashma Hydro-power Projects are already in advanced implementation stages. WAPDA is contributing its part for the identification, planning and design of small, medium and major hydro-power projects in the country. A large number of such projects are planned at different levels of study from identification to detailed engineering and implementation stage. HEPO has prepard a proposal for implementation and their investment to meet the future energy demand up to 2018, end of the 12th five year plan.

HYDEL POWER POLICY

Government of Pakistan has sought investment opportunities from private sector for their role in hydro-power development, mainly due to financial constraint in public sector. Previous Private Power Policy frameworks have predominantly resulted in private investement in oil and gas fired power plants, mainy based on imports fuel. The government now wants to play a proactive role in promoting the indigenous coal and hydro electric resources in power generation under new power policy 1998.

* Director (Electrical and Mechanical), Hydro-Electric Planning Organization, WAPDA.
** Deputy Director (Civil), Hydro Electric Planning Organization, WAPDA.

CONCLUSIONS

The ingress of thermal generation to meet the energy crisis has caused a drastic increase in tariff and resulted in switching of by major consumers to their own energy resources, giving rise to another sort of crisis.

Hydro-power development is the ultimate choice for filling the increasing power demand gap. It may be emphasized that the major hydro-power development should be carried out in public sector, whereas private sector be encouraged to participate in small to medium sized projects.

MANPOWER REQUIREMENTS IN HYDRO-POWER ENGINEERING

BY

Dr. J.J. Victoria* & Dr. Muhammad Latif**

Sufficient qualified technical pesonnel are necessary for a sustainable development of the available hydro-power resources of Pakistan. The energy requirements of the country should not be satisfied only on emergency basis. A well-organized and systematic approach is needed, with maximum participation of local experts, especially engineers.

Traditionally, foreign consulting and construction companies have carried out planning, design and implementation of medium and large size projects, such as Nandipur, Shadiwal, Warsak, Mangla, Tarbela and other plants.

The activities of local engineers have concentrated on the implementation of small projects, the majority constructed in the north of the country. Regretably, due to lack of expertise, many of these projects are not performing satisfactorily. Most of the plants have been constructed with temporary diversion works and without sand traps, leading to a quick deterioration of the rotating parts of the turbines. The situation is aggravated by low quality workmanship, causing poor performance, frequent outages of the plants due to damage of the project components.

A sizable hydro-power potential has been identified within the Indus Irrigation system and in the north of the country. Feasibilty studies are available or in progress for some low head projects at barrages and canal falls in the plains as well as for medium and high-head projects on Indus river and its tributaries in the north of the country. WAPDA at national level and SHYDO at provincial level have carried out the majority of these works with the collaboration of foreign personnel.

Only a limited number of Pakistani professionals have participated in these activities. Due to prevailing institutional policies, rotation of personnel is unavoidable. Therefore, the continuous involvement of local professionals working in governmental institutions is not ensured. It has happened many times that the trained persons (through on the job or formally trained) have been transferred to other quarters to carry out totally unrelated works, wasting completely their gained knowledge and skills.

To ensure the desperately sought self-reliance and autarchy in the energy sector Pakistan needs to institutionalize the development of specialized manpower in all relevant

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* Head of GTZ Civil Engineering Section under Pakistan German Technical Cooperation for "Programme for National Hydro-Electric Power Development in Pakistan".

** Director, Centre of Excellence in Water Resources Engineering, University of Engineering & Technology, Lahore

fields. Training activities should continue within the governmental institutions, such as the WAPDA Engineering Academy at Faisalabad. However, specific courses and programmes need also to be introduced at university level. This is especially important to provide the necessary manpower to implement projects in the private sector.

In this connection, CEWRE/UET Lahore and GTZ have been jointly working with the aim to establish a post graduate programme in "Hydro-power Engineering". Two short courses have already been carried out in the last six months with quite satisfactory results. Efforts are under way to start a new degree programme in Hydro-power at the Centre.

OPTIMIZATION OF HYDROELECTRIC PROJECTS

BY

Engr. Ch. Altaf-ur-Rehman*

Hydroelectric installations are of appreciable size and extent and involve large expense. The design must be on overall basis. All alternatives need to be examined and specifically for large catchment to ensure that the works not only meet present and future requirements but also optimize the sites. Following is obviously necessary:

i) Ensure that components of structures are designed relevant to each other and to the whole development.

ii) That initial development does not prejudice the ultimate development of not only the site but also of overall catchment development.

The civil works component account for most of the cost of an hydroelectric project and provide motive power for the generator and therefore their design involves decision which govern the design and operation of the generating equipment.

If the power load demand needs only part of the capability of a site and leaves further development to the demand, it be considered that the demolition and replacement of an hydroelectric installation is not un-economical owing to the size and cost of engineering works and their long life.

The initially planned development was different for both Ghazi Barotha and Chashma Hydel Projects. In each case State-of-Art concerns lead to the presently implemented schemes. Projects like Mangla and Tarbela were affected by State-of-Art of design turbines. Warsak dam hydrological data was scanty at the time of design.

In the light of the above evaluation of major constructed and being constructed Hydro Electric Projects following conclusion may be derived.

- The generation capability of both Ghazi Brotha and Chashma Hydel is under utilized.
- Mangla and Tarbela generation can be increased on refurbishment.
- Warsak has additional capability for more units.

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BRIEF REPORT ON MID TERM SYMPOSIUM

1.0 PREAMBLE

A mid-term symposium on 'Need for Hydropower Development to Solve Energy Crisis in Pakistan' was arranged and held by the Pakistan Engineering Congress on 22 April 1999 from 9.30 to 18.00 hrs. The symposium was inaugurated by Mr. Gauhar Ayub Khan Federal Minister for Water & Power.

2.0 BACKGROUND

2.1 Energy Crisis in the Country

The effects of current energy crisis on the national economy cannot be over emphasized. Pakistan, despite being endowed with large indigenous hydropower resources, has recently suffered a rapid switch-over to expensive thermal power development which has caused a significant rise in tariff for consumers. The ratio of hydel vs thermal power generation was about 60:40 in sixtees which has been converted to about 32:68 in 1997 due to postponement of the construction of major hydro power projects, like Kalabagh Dam Project, that have after quite some-time been ready for execution. Consequently, the economy of the country had to suffer not only in energy sector but also significantly in agriculture and industrial sectors. Due to drastic rise in tariff, major consumers have started to generate their own energy resources which is liable to give rise to another sort of crisis.

The energy demand has an inclining trend and the power shortfall will keep on accumulating causing future energy crises in the country. It is expected that the peak power demand in 2018 will be 46681 MW. It will result in shortage of 31,625 MW required to be met through either hydel or expensive thermal development.

2.2 Undeveloped Hydropower Potential

Pakistan is gifted with abundant hydel resources. It is a pity that Pakistan's power shortages are met from thermal power rather than cheaper hydel alternative, which is not only environmental friendly but its perpetually available/renewable source of energy is a bounty of nature in contrast to environmentally hazardous, non-renewable sources of energy for thermal power.

Pakistan has a potential of at least 35,000 MW of hydel power still awaiting to be harnessed on the main rivers and another approximately 10,000 MW on the tributaries. In addition to this high-head potential in the mountainous areas, there is another 550 MW of low-head potential in the plains on existing canals and barrages.Unfortunately this vast energy potential is presently not being developed. There is a definite need to streamline the development of hydropower in Pakistan.

2.3 The Need for a Symposium

In compliance with the Prime Minister's Directive for Self Reliance, and the need for sustainability of the Technical Cooperation Programs, it is essential that the knowledge to develop the Hydro Power Potential in Pakistan and awareness of its availability and benefits should be disseminated widely with the objective of promotion of hydro power in Pakistan.

In view of the above and paramount significance of the current energy crisis and its devastating effects on the national economy, the Executive Council of Pakistan

Engineering Congress decided to hold a mid-term symposium of its 68th session on "The Need for Development of Hydro Power to Solve Energy Crisis in Pakistan".

2.4 The Proceedings of the Symposium

The symposium was held on 22-04-1999 from 9.30 to 18.00 hours. Mr. Gauhar Ayub Khan, Federal Minister for Water and Power inaugurated the Symposium as the Chief Guest for the occasion. The importance of Hydro-power Development and need for harnessing all hydel resources was explained in the Address of Welcome presented by Engr. S.N.H. Mashhadi, President Pakistan Engineering Congress and the Key Note Address presented by Engr. Ch. Ghulam Hussain, Convener Symposium Committee. The Chief Guest in his Inaugural Address also supported the concept and agreed to the need for realistic programming for Hydro Power Development.

In the two technical sessions which followed the inaugural session, 8 papers were presented by National and International experts in the Hydro-power Science and Engineering. These papers were discussed by the delegates who attended the Symposium from all parts of the country and in their own rights were also specialists of the subject.

2.5 Technical Papers Presented in the Symposium

Genuine efforts were made by the authors of the following papers included in this Symposium towards achievement of this objective.

(i) "Hydroelectric Power Potential Identified on the Tributaries of the Indus additional to the Potential on the Main Stem of the Indus River". This paper identified the hydropower potential on the tributaries.

(ii) "Role of Low Head Potential to Meet the Energy Crisis in Pakistan" deals with past, present and future of low-head hydropower development in Pakistan.

(iii) It is obvious that no planning can be done without reliable data bank. It takes a lot of time, effort and money to build up such data banks. A paper entitled "Available Data Bank and Information on Hydropower" contains very extensive information in this respect.

(iv) Transformation of power sector into a privatized/ competitive industry will evolve over time, however in the interm period it would be necessary to create an environment of facilitating the efforts of independent power producers (IPP's) towards this end and particularly through development of the indigenous hydro power resources. A paper entitled "Facilitation of Hydropower Development by Independent Power Procedures" was also presented in the Symposium.

(v) Keeping in mind the present trend for privatization, a paper on "Feasibility Studies Ready for Involvement of Private Investment under 1998 Power Policy" was especially included in this Symposium.

(vi) A paper captioned "Development of Hydropower to Meet Energy Crisis of the Country" highlights energy crisis, hydropower potential, development strategy of hydropower in public sector and salient features of new Hydel Power Policy of 1998.

(vii) With regard to self-reliance, there is a definite need to improve and develop the Local Consultancy Institutions and Construction Industry. To achieve this important goal, we have to build up our own specialized technical manpower. The symposium proceedings include a paper entitled "Manpower Requirements in Hydropower Engineering" to cover this critical aspect.

(viii) Hydro-electric installations are of appreciable size and extent and, therefore, involve huge investments. A paper on "Optimization of Hydro-electric Projects" identified the significance of this subject.

3.0 RECOMMENDATIONS

A panel discussion was held on 26-05-1999 in which 11 specialists participated to finalize the conclusions and recommendations for the Symposium.

Final recommendations were prepared by this panel of experts convened under Chairmanship of Engr. Shahnawaz Khan, Ex-Chairman WAPDA in the light of proceedings of the Symposium. Based on above the following recommedations are presented for consideration and a positive action by the Government:

3.1 Despite excessive installed capacity the power consumers are in serious kind of crisis as the tariffs are getting beyond their affordability. Accordingly the hydropower output should not be surcharged with taxes and duties so that the benefit of low generation cost from God's free gift of flowing river waters are passed on to keep down the energy cost to industry, agriculture and domestic consumers. The present situation of high costs of power is hurting the economy and social sector very badly.

3.2 To cope with future requirements effectively and efficiently, there is no alternative but to have maximum reliance on hydropower. This, infact, endorses July, 1998 IPP Policy, which prescribes that all new power projects will be based on hydropower or indigenous coal. It is an established fact that hydropower is much cheaper than the thermal production of power.

3.3 Hydropower development should be through synergetic efforts of all concerned in the following sequence of priority as per as possible:-

a) Construction of large projects on the main rivers and major tributaries, through multi-purpose storages in the public sector.

b) Construction of medium-sized projects involving small storages on tributaries 8 main rivers, jointly by public / private sector. This carries priority No. 1, because in addition to cheap hydel power, it also provides stored supplies which are urgently needed to meet,

i) growing shortage of water due to siltation in our existing reservoirs and;

ii) rising demand of food & fibre for our future generations.

c) Construction of small to medium-sized projects on the tributaries & canal falls by the private sector.

3.4 The multi-purpose Kalabagh Dam Project should be implemented on priority basis followed by Basha Dam Project to lay firm foundations for systematic development of

MAP PROJECTION

By

Engr. A.W.Mir

Introduction

The objective of this article is to try and explain this generally considered, dull and complex subject in simple terms for practising engineers/surveyors.

Map making involves plotting or showing graphically on a piece of paper which is a flat surface, the features, man made and natural, existing on or near the surface of earth which is a curved spherical surface, or in otherwords representing or projecting curved surface on a flat surface.

In the case of small areas the surface earth is assumed to be flat for all practical purposes and where large areas of the earth are involved the assumption of flat surface is no more true. The distortions creep in and to minimize the effect of map distortions various forms of projection are employed.

Classifications

A perfect map projection will have;

i. all distances and areas in correct relative magnitudes.
ii. all azimuths and angles correctly shown.
iii. the geographic coordinates (latitudes and longitudes) of all points correctly shown and
iv. great circles appears as straight lines.

But such a map projection does not exist or can not be created. We, therefore, have the following types of map projections;

i. conformal or orthomorphic projection, angle between any pair of sort interecting lines appear correct and this results in small areas appearing in correct shape. Shape of the large areas is incorrect.
ii. equal area projection, here the stress is on proper relative size and these areas may be largely out of shape and also have other deflects.
iii. equidistant projection, distances are correctly represented from one central point to other points on the map.
iv. azimuthal projection, it shows direction of azimuth of any point relative to one central point.

Common Map Projection

The two most common projections that our engineers/surveyors are likely to come across in practical life are;

i. Mercator Projection and Transverse Mercator Projection.
ii. Lambert conformal Conical Projection.

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Mercator Projection can be visualized as an ellipsoid projected onto a cylinder with tangency established at the Equator with polar axis of the ellipsoid in coincidence with the cylinder as axis, (Figure No.1) when the cylinder is opened and flattened, a distortion appears in the polar regions, in as much as the line representing the equator is the true distance and each parallel is represented by a line as long as the Equator. The poles are infinitely distant from the Equator and can not be shown on the projection. Distortion becomes more propounced as the distance north and south of the Equator increases. For example, the map scale at 60° north and 60° south is approximately twice that at the Equator.

Transverse Mercator Projection is a Mercator Projection where the cylinder has been rotated or transversed 90° (Figure No. 2) The ellipsoid and cylinder are thus tangent along a meridian. By projecting the surface of the ellipsoid onto the cylinder in the same manner as for the Mercator Projection, the transverse mercator projection is developed on the surface of the cylinder which is then opened and flattened.

The scale is true along the central meridian and it also used as origin for X Coordinate of the map. The origin of Y coordinate is the equator. The four basic properties of this projection are;

1) the central meridian and the normal to it are represented by straight lines.
2) other meridians are complex curves that are concave towards central meridian.
3) parallels are concave towards the pole.
4) the scale is true only along central meridian.

Universal Transverse Mercator (UTM), is entirely based on transverse Mercator projection. The whole world is split up into zones 6 degrees wide, (3° either side of the central meridian), all distances with 3° belt of the meridians are relatively accurate. The unit is meter, the zones are numbered beginning with 1 for zone between 180°W and 174°W meridians and increasing to 60 for the zone between meridians 174°E and 180°E (Figure No.3).

The origin of longitude is at the central meridian and origin of latitude is at the equator. The scale factor at central meridian is 0.9996 and latitude for the system varies from 80°N to 80°S.

Lambert Conformal Conical Projection

It is the most widely used projection world wide and was developed by John Heirich Lambert (in 1772) the same year as he invented transverse Mercator projection. It is suitable for regions or states with greater east-west than north south extent.

It can be visualized as the projection on to a cone whose axis coincides with polar axis of the ellipsoid (Figure No.4)

The cone is secant to te ellipsoid, intersecting along two parallels of latitude. These two parallels are called standard parallels. Meridians appear as straight lines radiating from a point beyond the mapped areas. Parallels appear as arcs of concentric circles which are centered at the point from which the meridians radiate. None of the parallels appear in exactly the projected positions; they are mathematically adjusted to produce the property of conformality. This adjustment is slight if the standard parallels are sufficiently close together.

The characteristics of the two main projections;

Characteristics	Transverse Mercator	Lambert Conformal
Origin of Projection lines	A point on the diameter varying with the latitude, between the center and the opposite side.	axis of cone near center of ellipsoid.
Development Surface	Cylinder	Cone
Tangency	Control meridian	Control Parallel
Secancy	Two easting equidistant from the control meridian.	Two standard parallels of unity scale factor.
Parallels	equator is a straight line; all other are curves concave toward the nearest pole.	Arcs of concentric circles whose spacing increases away from the central parallel.
Meridians	Central Meridian is a straight line; all others are curved lines, concave toward the central meridian.	straight lines converging on the projected polar axis.
Scale Distortion	Tangent-increases away from central meridian, secant – increases outward from secancy, decreases toward central meridian (see figure 4)	Increases outward from standard parallels; decreases between standard parallels.
Rhumb Line	Curved line	Curved line
Great Circle	Curved line except central meridian and equator	Approximate a straight line when between standard parallels.
Use	Topographic – 1:50,000 and larger hydrographic – 1:50,000 and larger aeronautical – 1:250,000	Topographic – 1:1,000,00 and smaller aeronautical – 1:500,000 and smaller

References

1. Defense Mapping Agency
   Technical Manual 8358. 1
2. Geodesy for the Layman – TR 80-003-NIMA
3. Surveying
   David, Foote & Kelly

Figure No. 1

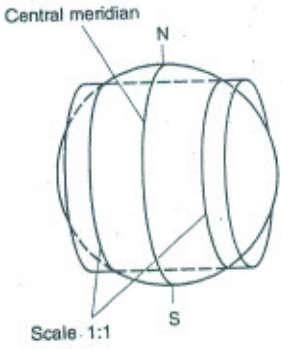
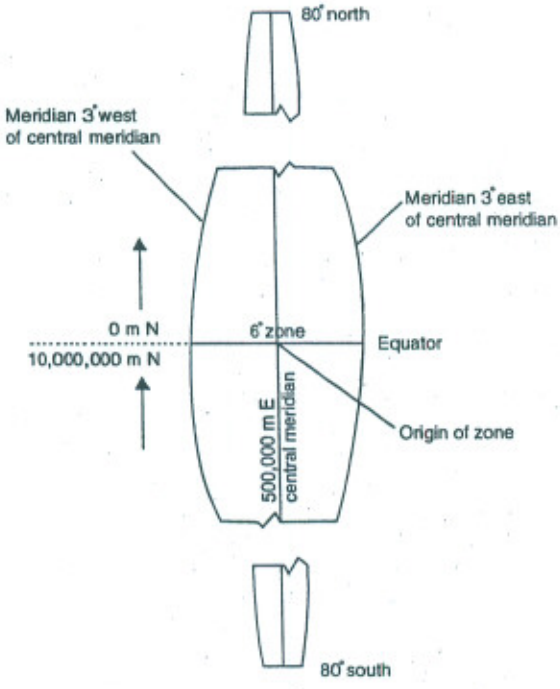


Figure No. 2



Universal Transverse Mercator (UTM)

Figure No. 3

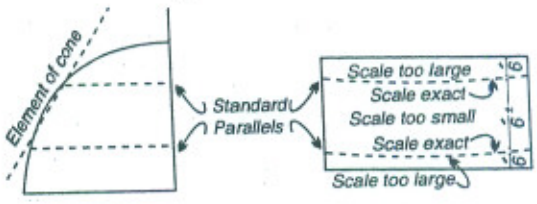


Figure No. 4

DEVELOPMENT OF SIMPLE TECHNIQUES FOR MEASUREMENT OF WATER IN THE DISTRIBUTARIES AND WATERCOURSES

By
Engr. Arshad Ali Choudhry *& Engr. Mahmood Hussain Raja**

Abstract

Measurement of water at the distributary and watercourse level is essential to ensure that water rights are maintained and equity in distribution is achieved under Participatory Irrigation Management (PIM) programme. In the distributaries, water measurement structures (which are mostly open flumes) are available and regularly read to make an assessment of the flow. However, at the watercourse level, moghas which can measure discharge quite accurately, are often not used for this purpose which is essential for efficient flow distribution and management in the watercourse commands.

It is always advised that moghas should be used as measurement structure on each watercourse. But measurement of the mogha discharge is quite a technical job for which the farmers do not have the required skill. In order to enable farmers to measure mogha discharge quite conveniently, some simple and workable arrangements / techniques, which do not involve much data collection and use of formulas, need to be developed by the field staff. This paper describes those arrangements that the field staff need to make on the moghas / distributary so that the farmers, may be able to make use of them. In addition, for improved watercourses, use of discharge gauges by the farmers has been proposed. The method to be followed by the field staff for their development and use for noting the watercourse discharge is also explained.

Introduction

Measurement of water at the distributary and watercourse level is essential to ensure that water rights are maintained and equity in distribution is achieved under Participatory Irrigation Management (PIM) programme. In the distributaries, water measurement structures (which are mostly open flumes) are available and regularly read to make an assessment of the flow. However, at the watercourse level, moghas which can measure discharge quite accurately, are often not used for this purpose which is essential for efficient flow distribution and management in the watercourse commands. Instead (for the sake of flow measurement in the watercourses), it is often advocated to install some measurement structure, which may be often feasible because many watercourse commands in Pakistan have insufficient head to provide farmers on the watercourse their authorized flow rate and because apropriate cleaning of water courses is often not done regularly, consequently the outlets / moghas become submerged reducing thereby the water supply to these watercourse commands. Adding a water measurement structure to these watercourses may further reduce the water supply that is available to the farmers because the head loss through the structure will further submerge the mogha or cause it to be submerged sooner because of poor watercourse cleaning.

In the light of these circumstances, unless there are some compelling reasons for not using the existing mogha for water measurement, it is always advised that moghas should be used as measurement structure on each watercourse. But measurement of the mogha discharge is quite a technical job for which the farmers do not have the required skill. In order to

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** Team Leader, Third Punjab OFWM Project Consultants Multan.

enable farmers to measure mogha discharge quite conveniently, some simple and workable arrangements / techniques,, which do not involve much data collection and use of formulas, need to be developed by the field staff. This paper describes those arrangements that the field staff need to make on the moghas / distributary so that the farmers, may be able to make use of them. In addition, for improved watercourses, use of discharge gauges by the farmers has been proposed. The method to be followed by the field staff for their development and use for noting the watercourse discharge is also explained.

A. Measurement of Mogha Discharge

On our irrigation canals generally three types of moghas (namely pipe, open flume and Apm) have been installed for water diversion and measurement. To build the capacity of the farmers for measuring the discharge of these different moghas, the arrangements described under each mogha below will have to be made by the field staff.

1 Pipe moghas

Basic information about the mogha

Pipe moghas operate under two types of flow conditions (i) free flow condition and sub-merged flow condition. When the downstream end of the pipe of mogha is above the full supply level in the watercourse, the mogha is said to flow freely. However, when the downstream end of the pipe of the mogha is sub merged and discharges below the FSL of watercourse, the mogha is known to operate under submerged flow condition. Under both the above flow condition, the mogha discharge is calculated with the help of the discharge equation which has the following general form:

$$q = cd \times a \times \sqrt{2gh} \qquad \ldots\ldots(1)$$

Where:

cd	=	discharge coefficient
a	=	cross sectional area of pipe
g	=	acceleration due to gravity, the value of which is 32.2 ft/sec/sec in fps system and 9.81 m/sec/sec under metric system.
h.	=	head of water. In case of free flow conditions the depth of water in the canal above the center of the pipe is the head of water. "h". In case of submeged flow conditions difference of elevations of FSL in the canal & FSL in the watercourse which in known as the differential head (hd) is used as a head of water.

Thus in case of submerged flow conditions mogha discharge is calculated using the value of h_d in the discharge formula as below:

$$q = cd \times a \times \sqrt{2gh_d} \qquad \ldots\ldots(2)$$

Procedure for discharge measurement

When ever mogha is to be used as a flow measuring structure, it must be first calibrated as explained below:

(a) Determine the value of Coefficient of discharge C_d. The value of C_d for the pipe mogha which is not tampered is normally 0.65. However, if the mogha is damaged by the farmers, this value of C_d may change. It is thus always advisable to determine the value of C_d on site before starting the discharge measurement programme. For this purpose the following procedure is used.

(i) Determine the mogha discharge installing a flume in the watercourse or using the manning equation if the watercourse is lined.

(ii) Measure the dia. of the mogha pipe and find out its area in m^2 or ft^2.

(iii) Find out the working head "h" or "hd". In case of mogha with free flow, find out the depth of water in the canal upto the centre of the pipe, it will give the value of "h". In case of submerged mogha, find out the value of "hd" i.e. difference of elevation of water surface in distributary and that of the watercourse. It can be done with the help of the engineer's level.

Now putting the above values in the basic discharge equation (1 or 2) for the pipe mogha, the value of Cd is calculated.

(b) Work out the value of the discharge constant by multiplying C_d with the area of pipe "a" and $\sqrt{2g}$ since the values of these parameters do not change.

Now whenever mogha discharge is to be determined find out the value of h or h_d and multiply it with the discharge constant, mogha discharge will be obtained.

It has been obseved that pipe moghas mostly flow under submerged flow conditions, free flowing moghas are not very common.

Arrangements for the Farmers for measuring the mogha discharge

In order to facilitate discharge measurement by the farmer, the following arrangements will by made by the field staff.

(i) Arrangement for measurement of "h_d" or "h".

For measuring the differential head "h_d", engineer level is needed which the farmers cannot use. Instead the following arrangements made by the field staff will facilitate noting the value of h_d.

Assume that the elevation of top of the face wall of the mogha is 10 meters. Paint this value on top of the face wall as shown in Figure-1. Fit the engineers level at a suitable place and take a reading by putting the staff rod on the top of the face wall. Add this rod reading to 10 for getting the height of the instrument (HI). Then put the staff rod on top of the wall of the lined watercourse and find out its rod reading. Subtract this rod reading from HI and determine its elevation. Paint this value on top of wall of watercourse as shown in Figure-2. Now these are the two established permanent reference points whose elevations are known.

For determining the value of hd, the farmers will simply find out the depth to the water surface in the distributary from the reference point and subtract it from 10.0. It will give the elevation of the FSL in the canal. Similarly they will also find the depth to the water in the watercourse from the reference point and subtract this depth from the elevation of the reference point. It will give the elevation of the FSL in the watercourse. Finding out the difference of the elevation of FSL of canal and elevation of FSL of watercourse, hd will be obtained.

In case of free flowing pipe mogha, the distance from the top of the face wall to the centre of the pipe in the canal will be measured and painted on the top of the face wall which becomes a permanent reference point. Now when ever value of "h" is to be determined, the farmers will measure the depth to the water surface in the canal from the reference point and subtract it from the value painted on the reference point, value of "h" will be obtained.

(ii) Preparation of a discharge table for the mogha.

This table shows values of mogha discharge against different values of "h" or "h_d". This table is developed by taking different values of "h" or "hd", taking their square root and multiplying them with discharge constant of the mogha for determining the discharge. A sample of a discharge table for mogha No. is shown in table-1.

How to read the mogha discharge

How, whenever, the farmers need to determine the discharge of the freely flowing pipe mogha, they will simply measure the depth to the water surface in canal from the reference point and subtract it from the distance painted on the top of the face wall. It will give the value of "h". They may now read the discharge from the discharge table against the value of noted "h".

In case of submerged pipe moghas, they will find the value of h_d as explained earlier and read the discharge against the noted value of hd in the discharge table-1.

Table-1

Discharge table for mogha No. 4813/L, D.G.Khan

Mogha pipe size (dia) = 25.2 cm
C_d Value = 0.60
Mogha discharge constant = 0.1355

Differential head "h_d"	Discharge	
Cm	1/sec	Cusecs
2	19.16	0.68
4	27.10	.97
8	38.32	1.36
10	42.84	1.53
12	46.94	1.67
14	50.69	1.81
16	54.20	1.93
18	57.48	2.05
20	60.59	2.16
22	63.55	2.27
24	66.38	2.37
26	69.10	2.46
28	71.69	2.56
30	74.22	2.65
32	76.65	2.73
34	79.00	2.82
36	81.30	2.90
38	83.52	2.98
40	85.69	3.06
42	87.81	3.14
44	89.88	3.21

Table - 3

Discharge table for mogha No.118100/R, Distributary 3L-BC, Chak No. 24/BC.

Tech. Data:-

(i)	Type of mogha	=	Open flume with roof block
(ii)	Dimensions	=	Bt = 0.164m (0.54 ft), Y = 0.21m (0.70 ft)
(iii)	Distance from the top of the reference point to the mogha crest	=	0.715m (2.35ft)
(vi)	Discharge constant	=	0.288

Distance from the top of the reference Point to the water Level in the canal Cm	Value of G cm	Discharge 1/Sec	Discharge cfs
45	26.5	39.2	1.40
46	25.5	36.96	1.32
47	24.5	35.0	1.25
48	23.5	32.76	1.17
49	22.5	30.80	1.10
50	21.5	28.84	1.03
51	20.5	26.88	0.96
52	19.5	24.92	0.89
53	18.5	22.96	0.82
54	17.5	21.0	0.75
55	16.5	19.32	0.96
56	15.5	17.64	0.63
57	14.5	15.96	0.57
58	13.5	14.28	0.51
59	12.5	12.60	0.45
60	11.5	11.20	0.40

Assuming that the slope, the value of n, and width of the lined watercourse section remain unchanged[1], the velocity of flow and the discharge will vary with the change in depth of flow in the watercourse. Based on this principle, the discharge gauge is developed which shows discharge at different depths. A complete method for the development of this discharge gauge is shown through the development of Table-4. This table has been prepared for developing a

[1] No dout the value of roughnes Coefficient "n" will increase if watercourses are not regularly cleaned. Farmers using these gauges will be advised to keep their watercourses clean to maintain the value of "n".

discharge gauge for watercourse No. 6300/l, Gaddai Minor, D.G.Khan. The basic data required for the purpose is given on top of the Table-4.

Once the table is developed, the values of discharge at different depths are engraved on the sheet of fibber glass according to scale starting from the lower edge which is taken as its zero depth.

Table-4

Preparing a discharge gauge for Watercourse No.6300/L, Gaddai Minor D.G.Khan

Data:-

b=0.84 V = $1/n \times R^{2/3} \times S^{1/2}$

S=0.0002 = $76.92 \times 0.020 \times R^{2/3}$

n=0.013 = $1.538 \times R^{2/3}$

Depth (cm.m)	Area (m^2)	$R^{2/3}$	Velocity (m/sec)	Discharge (litre/second)
53	0.254	0.304	0.470	119.4
50	0.240	0.301	0.460	110.4
48	0.230	0.298	0.458	105.3
46	0.220	0.294	0.452	99.4
44	0.210	0.291	0.450	94.5
42	0.200	0.287	0.440	88.0
40	0.192	0.285	0.440	84.5
38	0.182	0.281	0.430	78.3
36	0.172	0.277	0.430	73.9
34	0.163	0.273	0.420	68.5
32	0.153	0.268	0.410	62.7
30	0.144	0.264	0.410	59.0
28	0.134	0.258	0.400	53.6
26	0.124	0.252	0.390	48.4
24	0.115	0.246	0.380	43.7
22	0.105	0.238	0.370	38.8
20	0.096	0.231	0.350	33.6
18	0.086	0.222	0.340	29.2
16	0.076	0.211	0.320	24.2
14	0.067	0.201	0.310	20.8
12	0.057	0.187	0.290	16.5
10	0.048	0.173	0.270	13.0

Precautions for reading the watercourse discharge with discharge gauge

The following precautions must be observed while using the discharge gauge for reading watercourse discharge.

The discharge gauge may be placed along the two walls and then in the centre of the watercourse to record the flow and find out the average of these three readings. This may be repeated at 2 to 3 locations on a lined watercourse section to arrive at an average figure of the discharge.

The normal flow depth in a watercourse must be marked with paint. Similarly normal flow depth in the distributary also needs to be marked to note any increase or decrease in the distributary flow level. When the distributary flows above the marked level, one can understand that the flow in the distributary has increased which may also be experienced in the watercourse. But if the distributary flows normally and depth of water in watercourse increases, it must be understood that this is because the farmers are irrigating areas with higher elevation. This fact can be verified by determining the value of differential head which will be reduced causing a decrease in the mogha flow. Under this situation, the increase in depth of flow in the watercourse will accompany a decrease in its velocity. This situation will persist for a day or two, otherwise the water in the watercourse will flow at a normal depth, unless depth of flow in the distributary changes.

Under this abnormal flow situation try to be careful in reading the watercourse discharge with the discharge gauge. Determine the rise of water level above the normal depth of flow. For instance the normal depth of flow is 34cm and the present depth of flow is 41 cm in the watercourse. Place the discharge gauge in the watercourse and note the discharge and come down about 7 cm on the gauge and record the actual discharge. This can be verified by comparing it with the mogha discharge obtained by using the techniques described earlier. Under normal flow condition, however, the discharge gauge will read directly very accurate values of flow rate.

Some times, a farmer irrigates an area which is abnormally very low. In that case the velocity of flow in the watercourse will increase which will be accompanied by a corresponding decrease in the depth of flow. This can also be judged by noting the level of flow in the distributary. If it flows at its normal depth, one should understand, that decrease in the flow depth in the watercourse is due to irrigation of low lying areas. It is advised not to use the gauge during this abnormal situation which may prolong for a few hours. Watercourse discharge can, however, be calculated using one of the techniques described in the earlier section of this manual

C Water measurement in the distributary

Presently the Irrigation Department has installed open flumes at the head of each distributary/minor to measure their inflow. For this purpose, with each flume, a gauge has been installed along the wall of the convergent section on the upstream side (Figure-4). The zero of this gauge is fixed at the crest level of the flume. This gauge is read every day by the gauge reader appointed especially for this purpose. He has also been provided with a discharge table for the open flume. He reads the gauge and finds out the discharge with the help of the discharge table and records this in the register for transmitting it to the Officers concerned. This discharge table has been developed with the help of the discharge equation 4 described under the open flume moghas. It is very difficult for the farmers to read the discharge gauge installed for each open flume. White and black divisions of the gauge do not make any sense to them.

In order to make the whole procedure of measuring distributary/minor discharge simple and understandable to the farmers the following arrangements must be made.

i) A dischage table (Table-5) must be developed which should show discharges for different depths of water above the crest of the flume. Discharges for different depths of water above the crest of flume would be calculated using the discharge equation for the open flume.

ii) For measuring the depth of water above the crest of the flume the following arrangement is made with the help of the engineers level.

The distance from the top of the side wall, where gauge is installed, to the crest of the flume is determined. This distance is painted on top of this wall with the gauge. This becomes the reference point for measurement of the depth of water above the crest of the flume (Figure).

How to read the discharge of the distributary

Whenever the farmers have to read/measure the distributary discharge, they would simply measure the depth to the water from the reference point (Figure-5) and subtract it from the figure painted on the reference point to get the depth of water above the crest of the open flume (G). From the discharge table the distributary discharge would be easily read against this depth.

Table-5

Discharge table for the open flume installed on the 3L-BC distributary, Bahawalpur

Data:-

Width of the throat (BT) = 4.25 feet (1.3 meters)

Distance to the crest of flume from the top of reference point = 3.5 feet (1.15m)

Discharge constant = 12.75

Depth to the water in canal from the top of reference point	G	Discharge	
Feet	Feet	Cfs	M^3/sec.
0.1	(3.4)	79.9	2.24
0.3	(3.2)	72.98	2.04
0.5	(3)	66.25	1.85
0.7	(2.8)	59.74	1.67
0.9	(2.6)	53.45	1.50
1.1	(2.4)	47.4	1.33
1.3	(2.2)	41.6	1.16
1.5	(2)	36.06	1.06
1.7	(2.8)	30.79	0.86
1.9	(1.6)	25.8	0.72
2.1	(1.4)	21.12	0.59
2.3	(1.2)	16.76	0.47
2.5	(1)	12.75	0.36

Note: The scale on the gauge is engraved in such a way that each foot is divided into 10 equal divisions. Thus each division is equal to 0.1 foot.

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6. K.B. Khushalani and Manohar Khushalani 1990 "Irrigation Practice and Design", Vol. 4, Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi.

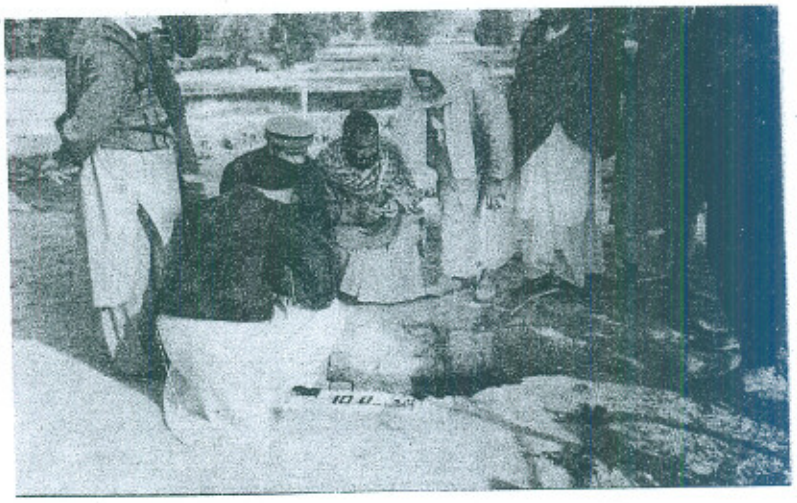

Figure 1: **Assumed elevation (10.0 m) painted on top of the wall of the Cistern in scratchley outlet (or face wall of pipe outlet).**

Figure 2:

Elevation of the of top the watercourse wall painted on it.

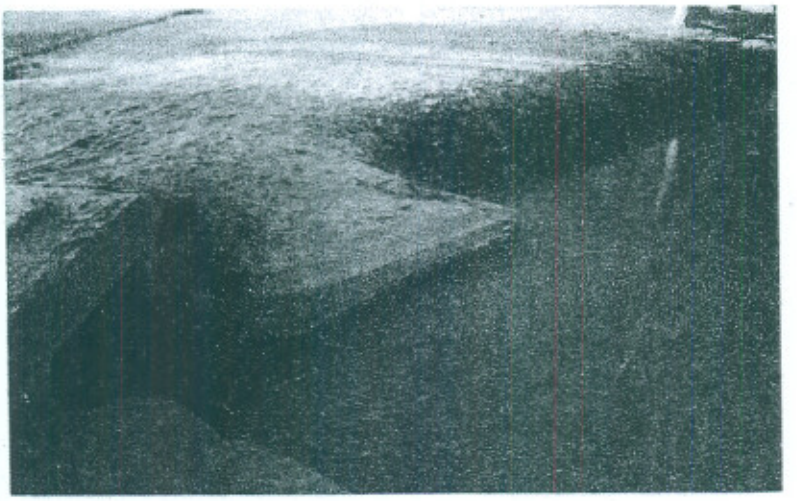

Figure 4: Discharge gauge installed in a distributary.

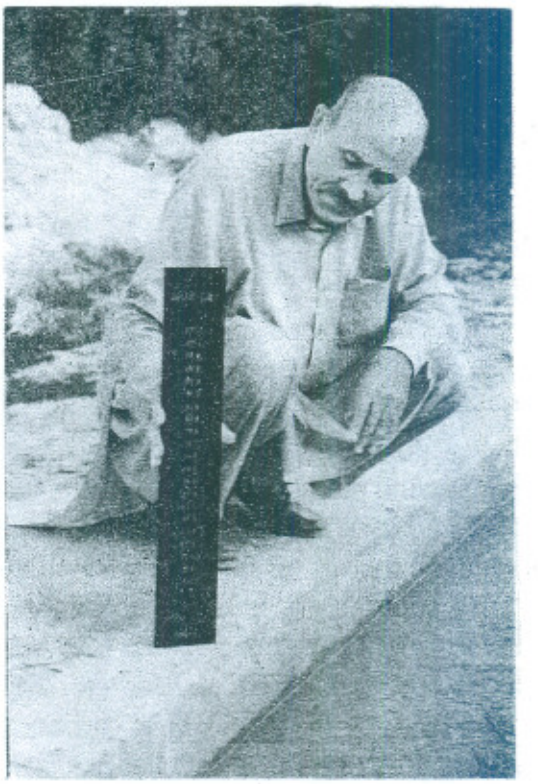

Figure 3:

Discharge gauge for measuring the watercourse discharge.

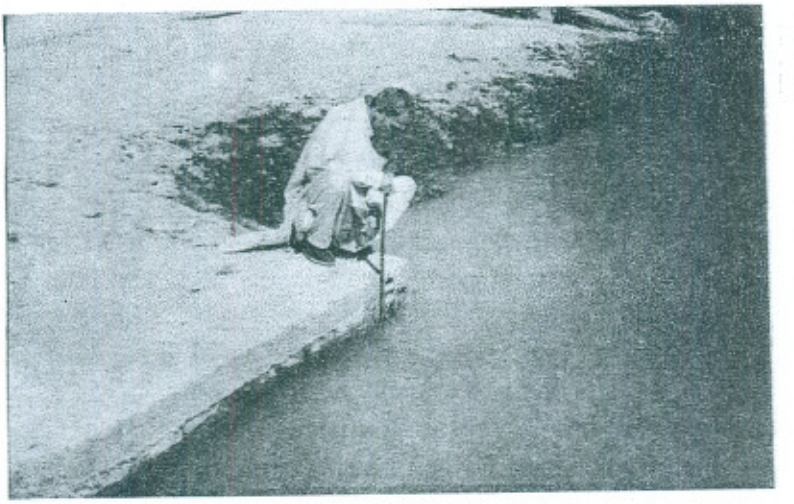

Figure 5: Noting the depth to the water level in the distributary from the reference point.

ENVIRONMENTAL DEGRADATION OF RIVER RAVI (SHAHDARA-BALLOKI REACH): PROBLEMS AND POSSIBLE SOLUTIONS

By
Engr. Shahbaz Asif *

1 Environmental Problems Faced by River Ravi (Shahdara-Balloki Reach)

Ravi used to be one of the active and clean fresh water tributaries of Indus Basin System. However, after Pakistan's independence and the ensuing Indus Basin Treaty (1960), its headwaters were completely diverted by India except during flood periods. Where River Ravi enters Pakistan from India, the freshwater supply that used to be several thousand cubic meters per second during pre-independence days, is now virtually zero. From there onwards, within the Pakistan territory, insignificant freshwater becomes available through small catchments besides some flow diverted by Marala-Ravi Link Canal from River Chenab of Pakistan. Nevertheless, these supplies are totally insufficient to dilute large quantities of waste effluent discharged into River Ravi. These conditions prevail right upto the outfall of Qadirabad-Balloki Link Canal, a few miles upstream of Balloki Barrage. Through subsequent construction of expensive dams and appurtenant diversion works, although relief to irrigation network has been attained, yet freshwater supplies of a major river cannot conceivably be restored to their pre-independence status. Drastic reduction of flows in Ravi has thus altered the flow regime causing severe impacts on the riverine ecology. Fish and other aquatic life has completely disappeared. Ponds of stagnant water have developed at various low-lying places due to lack of fresh water supply. These ponds contain toxic substances and pathogenic bacteria. The Raw sewage outfalling into the dried-up River Ravi has given the river bed a greenish texture at places releasing obnoxious odours. People living along both banks of the river are suffering from various water-borne diseases. Economic development combined with high rate of population growth has placed the waters, environment and the ecosystems of River Ravi under great stress.

Major urban and industrial centers located along upper reach of Ravi are shown in Fig 1 Disposal of domestic and industrial effluent in the face of virtual stoppage of fresh water flows has caused the river to become one of the filthiest in the world. Lahore City is the major source of municipal wastewater pollution. It is estimated that about 970,000 m^3/d with a BOD load of 255 t/d of untreated wastewater is discharged into the river. Sewage from Lahore reaches through three pumping stations at Shadbagh, Main Outfall and Babu Sabu as well as by gravity through Hundiara Drain from the left bank of Ravi as shown in Fig.1.

The industrial waste from Lahore Township Industrial Estate (LTIE) also reaches Ravi through Hudiara Drain. On the right bank, a number of drains bring in industrial and domestic waste as well as agricultural effluent. The effluent of Kala Shah Kaku (KKIC) and Sheikhupura

* Senior Engineer, NESPAK

Road Industrial Complexes is discharged through Deg Nala-1 and its tributaries. Main types of industries are chemicals, tanneries, printing and dyeing, carpets, paper and board mills, oil, food and ghee industries. Total number of industrial units are approximately 800 with an estimated effluent discharge of 131,000 m^3/d.

Various studies have been carried out to assess water quality of River Ravi, the recent one carried out under the National Conservation Strategy in 1996. Data collection was done at various important measuring stations and the results at important locations are shown in Table 1.

Table 1

Results of Water Quality Analysis at Important Locations

Distance (Km)	Locations	BODs (mg/1)	COD (mg/1)	DO (mg/1)	Chromium (mg/1)
0	Ravi Syphon	1.8	6.5	8.9	N.A
14	Old Highway Bridge	5.5	11	8.8	N.A
15	New Ravi Bridge	7.5	16	8.7	N.A
20	Main Outfall	18.9	40	5.5	1.2
28	Babu Sabu Outfall	23	45	4.9	0.3
45	Hudiara drain Outfall	21	44	2.6	0.9
77	Head Bolloki	7.3	10	6.3	0.1

N.A Not Available

As would be observed from the Table 1, toxic and heavy metals far in excess of acceptable limits, are present in the river, for instance, the maximum desirable level of chromium for aquatic life is 0.005 mg/1 whereas upto 1.2 mg/1 has been measured in the river. The polluted water also affects the quality of ground water beneath the city of Lahore as the groundwater flow pattern under the city is towards southwest with a cone of depression in the centre of the city. Any untreated sewage and industrial waste discharged upstream of Lahore is liable to pollute the ground water resources under the city.

2 Current Strategies for Improvement of Water Quality in River Ravi

There is no specific plan for improvement of water quality of Ravi but it is covered under various plans being implemented for conservation of rivers in general in Pakistan. The environment conservation plans may be broadly classified under three action plans covering pollution from (1) domestic sewage, (2) industrial waste, and (3) agricultural effluent. These plans are briefly described hereinafter:

2.1 National Conservation Strategy

National Conservation Strategy (NCS) is being implemented under directions of Environmental and Urban Affairs Division, Government of Pakistan (GoP). The NCS aims at drafting and promulgation of strategies for pollution control from industrial, and domestic wastewater and solid waste disposal. The NCS has made recommendations to adopt wastewater treatment technologies that provide recovery and reuse of water, nutrients and organic matter and economize the treatment processes. Following were the main recommendations for pollution control given under NCS Project.

2.1.1 Control of Pollution from Domestic Effluent

- Adopt wastewater treatment technologies that provide for recovery and reuse of water, nutrients and organic matter in safe and profitable manner;
- Develop systems for safe sewage irrigation;
- Use sludge as fertilizer and for soil amendment;
- Develop effective municipal garbage purchase mechanism;
- Promote generation of energy from human waste by private sector;
- Ensure proper landfill practices;
- Establish legal, institutional and pricing systems and incentive.

2.1.2 Control of Pollution from Industrial Waste

- Adopt regulatory approach on industrial discharges;
- Encourage reduction of pollution at source and recovery of heavy metals before discharge;
- Adopt measures for recovery and reuse of heavy metals;
- Promote biological methods for energy development;
- Promote reuse and recycling of solid and liquid waste;
- Disposal on land, provided leaching of heavy metals to groundwater does not occur to hazardous level;
- Provide alternative disposal methods backed by regulations preventing discharge into municipal sewers;
- Develop biological methods for recovery and re-use of heavy metals.

2.2 National Drainage Programme-Agricultural Effluent

National Drainage Programme (NDP) of Pakistan relates to water resources management strategies and one of the main objectives of the programme is the control of agricultural drainage effluent and pollution of water bodies. The main objectives of the programme are aimed at minimization of drainable surplus and environmentally safe disposal of the effluent. In order to achieve these targets, the approach towards river water quality improvement under NDP is as follows;

- Formulation of sustainable National Water Policy;
- Integrated approach towards National surface drainage system for the Indus Basin;
- Wetlands management plan;
- Balochistan effluent disposal;
- Flood protection and drainage of Peshawar valley;
- Exploitation and regulation of groundwater;
- Institutionalized environmental monitoring of land and water qualities;
- Protection of drainage water from pollution by municipal effluent;

- Reduction of drainable surplus by biological control.

3i Framework for Implementation of Strategies

The framework for implementation of water pollution control strategies in rivers may be broadly classified into three categories as described hereunder:

3.1.1 Social Framework

The social factors for successful environmental conservation of rivers in Pakistan are cognition, comprehension, attitude, action and behaviour. The social framework for environmental conservation places Pakistan at cognition stage and the people are currently being familiarized with environment and its conservation. The social framework for conservation of River Ravi can be through mobilization of public advocacy groups, community based organizations and the non-governmental organizations (NGOs). Such organizations are also taking part in other activities for conservation of environment.

The Environmental Protection Agency (EPA) alongwith NGOs have managed to establish environmental clubs in educational institutions and also drafted reference books for teachers. They are also seeking changes in educational syllabus by adding conservation of environment as a part of the curriculum.

3.1.2 Institutional Framework

The institutional arrangements for conservation and rehabilitation of rivers are almost non-existent apart from the organizations responsible for general environmental protection and management. The Punjab Environmental Protection Agency is playing the main role in environment protection in the Province. The Environmental and Urban Affairs Division and Pakistan Environmental Council are working at Federal level for master planning for the conservation of environment. Other agencies involved in conservation of River Ravi are the Industries Department, Water and Sanitation Agency (WASA) and Lahore Development Authority (LDA). WASA under top supervision of LDA is charged with primary role in management of sewage disposals into the River. WASA has been involved in planning and design of municipal wastewater treatment projects but the work has stopped due to the ongoing privatization of WASA. WASA after privatization may be suitable organization for planning and management of domestic wastewater treatment projects. Not many NGOs are working on conservation of River Ravi although some NGOs and CBOs are involved in solid waste management in Lahore.

3. 1 .3 Legal Framework

For the first time, "Environmental Pollution and Ecology" was added in the constitution of Pakistan in 1973 among the Federal and Legislative List. EPA Punjab was established in 1987 and has been responsible for issuing licenses to new industries and a certain level of monitoring of pollution. National Environmental Quality Standards (NEQS) were established and enforced in 1994 for new industrial units, and in 1996 for existing industrial units. These standards are given in Table 2. Environmental Protection Act (1997) replaced the Pakistan Ordinance (1983). This act lays down future regulation of industry through compliance of NEQS and also by equipping the EPAs with requisite powers.

Table 2

NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS)

For municipal and liquid industrial effluents (mg/1, unless otherwise defined)

No.	Parameter	Standards
1.	Temperature	40°C
2.	PH Value	6-10 pH
3.	5-days Biochemical Oxygen Demand (BOD)[1] at 20°c	80
4.	Chemical Oxygen Demand (COD)[1]	150
5.	Total suspended solids	150
6.	Total dissolved solids	3500
7.	Grease and oil	10.0
8.	Phenolic compounds (as phenol)	0.1
9.	Chloride (as Cl)	1000
10.	Fluoride (as F)	20.0
11.	Cyanide (as CN)	2.0
12.	Anionic detergents[2] (as MBAS)[3]	20.0
13.	Sulphate (SO_4)	600
14.	Sulphide (S)	1.0
15.	Ammonia (NH_3)	40.0
16.	Pesticides, herbicides, fungicides and insecticides	0.15
17.	Cadmium	0.1
18.	Chromium[4] (trivalent and hexvalent)	1.0
19.	Copper[4]	1.0
20	Lead[4]	0.5
21.	Mercury[4]	0.01
22.	Selenium[4]	0.5
23.	Nickel	1.0
24.	Silver	1.0
25.	Total toxic metals	2.0
26.	Zinc	5.0
27.	Arsenic	1.0
28.	Barium	1.5
29.	Iron	2.0
30	Manganese	1.5
31.	Boron	6.0
32.	Clorine	1.0

Notes:

1. Assuming minimum dilution of 1:10 on discharge. Lower ratios would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency.
2. Assuming surfactant as bio-degradable.
3. MBAS means Modified Banzene Alkyl Sulphates.
4. Subject to total toxic metals discharge as at No. 25.

Source: The Gazette of Pakistan Extra August 29, 1993.

These water quality standards (NEQS) provide a framework for maintenance and improvement of water quality. Work is still being done to improve these standards as some of the limitations of these standards are: these standards do not take into account the quality and assimilative capacity of the receiving body (e.g. Ravi condition is deplorable) certain parameters

such as Nitrates, Nitrites and Coliforms are not taken into consideration. Inspite of these limitations, the enforcement of NEQS is a definitive step in the right direction. The government has already constituted a committee to review these standards and make them more realistic and practical. EPAs are now empowered to enforce these standards through legislation but the NEQS are not fully enforced due to reasons such as financial constraints, capacity building of the departments and monitoring of water quality.

4 Recommendations

As discussed before, River Ravi as a unique problem where the flow regime has been totally destroyed (for 9 months it is virtually dried up and devoid of any fresh water supplies from India), and rapid development and urbanization, especially along upper reaches of Ravi, has made it to become one of the filthiest rivers in the world. It is the obligation of both government, communities and industry to mobilize all possible resources and start rehabilitation of Ravi as soon as possible. Non governmental organizations, community based organizations can play a vital role in the conservation and rehabilitation of the river. Ensuing paragraphs contain some broad recommendations that may help in conserving and rehabilitating the environment and ecology of Ravi.

4.1 Minimum River Flows

A certain quantity of water diverted from other rivers of Pakistan should be reserved as Ravi's minimum due share. This water may be added to Ravi upstream of Shahdara through link canals and by conserving water by adapting new on-farm irrigation practices.

4.2 Institutional Changes

In current institutional setup there is no field organization as such that is responsible for Ravi's conservation and rehabilitation on ground. It is recommended that radical institutional changes be made in the current set up. The change can best come through the establishment of an organization such as 'Ravi Conservation and Rehabilitation Authority'. The authority should be established through an Act and should monitor, undertake necessary work and regulate the water quality and environmental degradation of Ravi. The authority should have legal powers to enforce penalties on defaulters.

The authority should also act as a coordinator between various agencies. Efficient usage of annual flood flows during monsoon period for the purposes of optimizing their washing/leaching benefits, and monitoring of encroachments along the banks may also be amongst the functions of the authority. The authority should be partly self-financing by generating its funds by imposing additional tariffs on effluent producers and other beneficiaries. In order to clean up Ravi, it may be necessary to construct treatment plants in phases. Partial financing should be generated through a direct charge on recipients of services.

4.3 Water Quality Monitoring Programme

Regular water quality monitoring programme should be started forthwith. Samples should be collected and tested on monthly basis. All major effluent drains and tributaries of the river must also be sampled. The monitoring should include various industrial units discharging effluent into the drains, which finally reaches Ravi. These units should be asked to furnish their effluent analyses on monthly basis and random sampling by governmental agencies should also be carried out and reported to the proposed Ravi Conservation and Rehabilitation Authority.

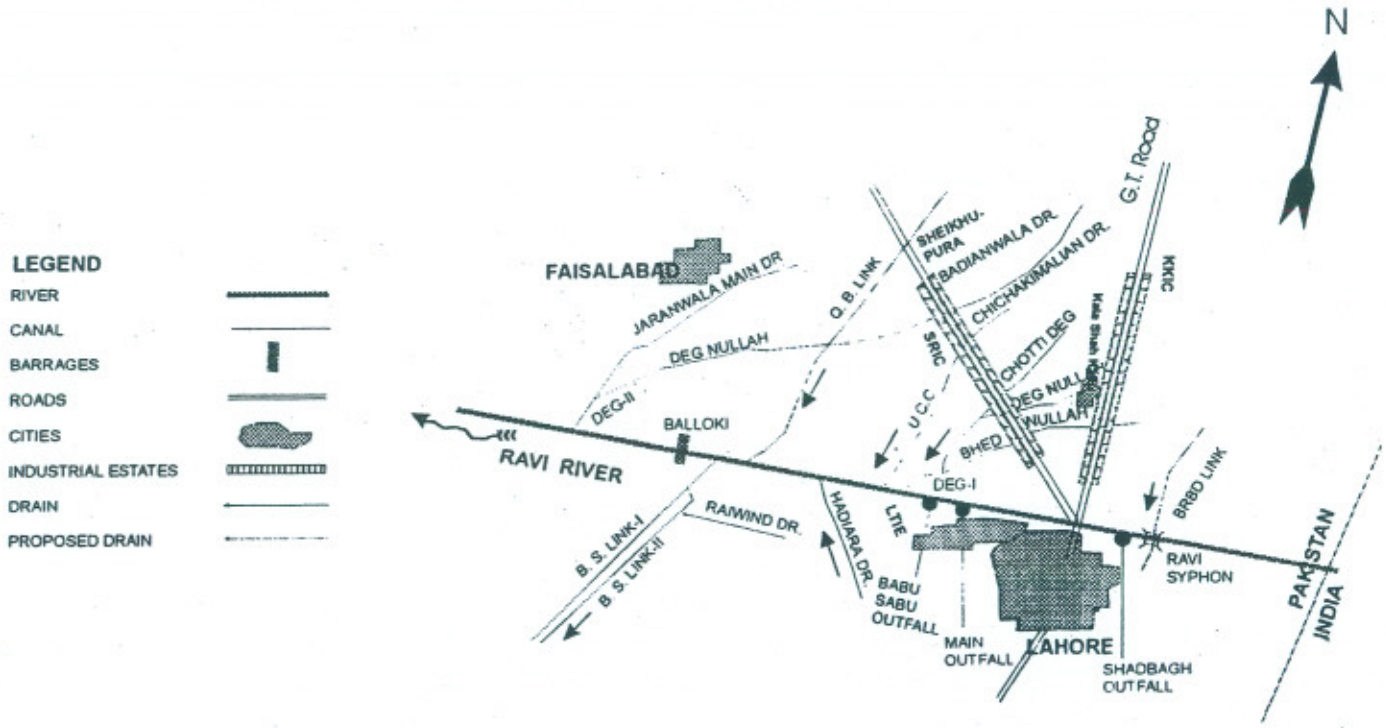

Figure 1- Waste Water and Agricultural Effluent Disposal into Upper Ravi Reach

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Ownership:
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Personnel:

Civil Engineers	95
Agricultural Engineers/Agronomists	10
Electrical & Mechanical Engineers	4
Allied Professionals / Scientists	10
Hydrologist / Geologist	4
Social Organizers	26
Administration & Accounts	66
Technical Support Staff	35
Non-Technical Support Staff	165

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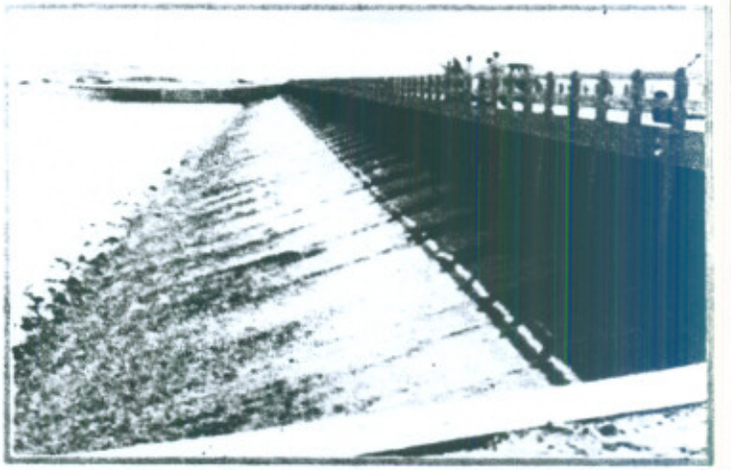
- Forestry and Rural Sociology
- Project Management and Construction Supervision
- Electrical and Mechanical Operations
- Roads and Bridges
- Environmental Engineering
- Tunnels
- Residential Buildings and Urban Development

TYPICAL PROJECTS

- Chashma Right Bank Irrigation Project Stage-III Client: WAPDA
- Pehur High Level Canal Project Client: Government of NWFP
- Swabi Salinity Control and Reclamation Project Client: WAPDA
- Fordwah Eastern Sadiqia South Project Client: WAPDA
- Post Flood Rehabilitation and Protection Project Client: Government of Pakistan
- Marala Ravi Link Canal System Restoration and Improvement Project Client: Government of the Punjab
- Punjab Private Sector Groundwater Development Project Client: Government of the Punjab
- Remodelling Thal Canal Project Client: Government of the Punjab
- National Drainage Programme Client: WAPDA



A completed Superpassage in Operation on Chashma Right Bank Canal Stage-II (NWFP) Pakistan