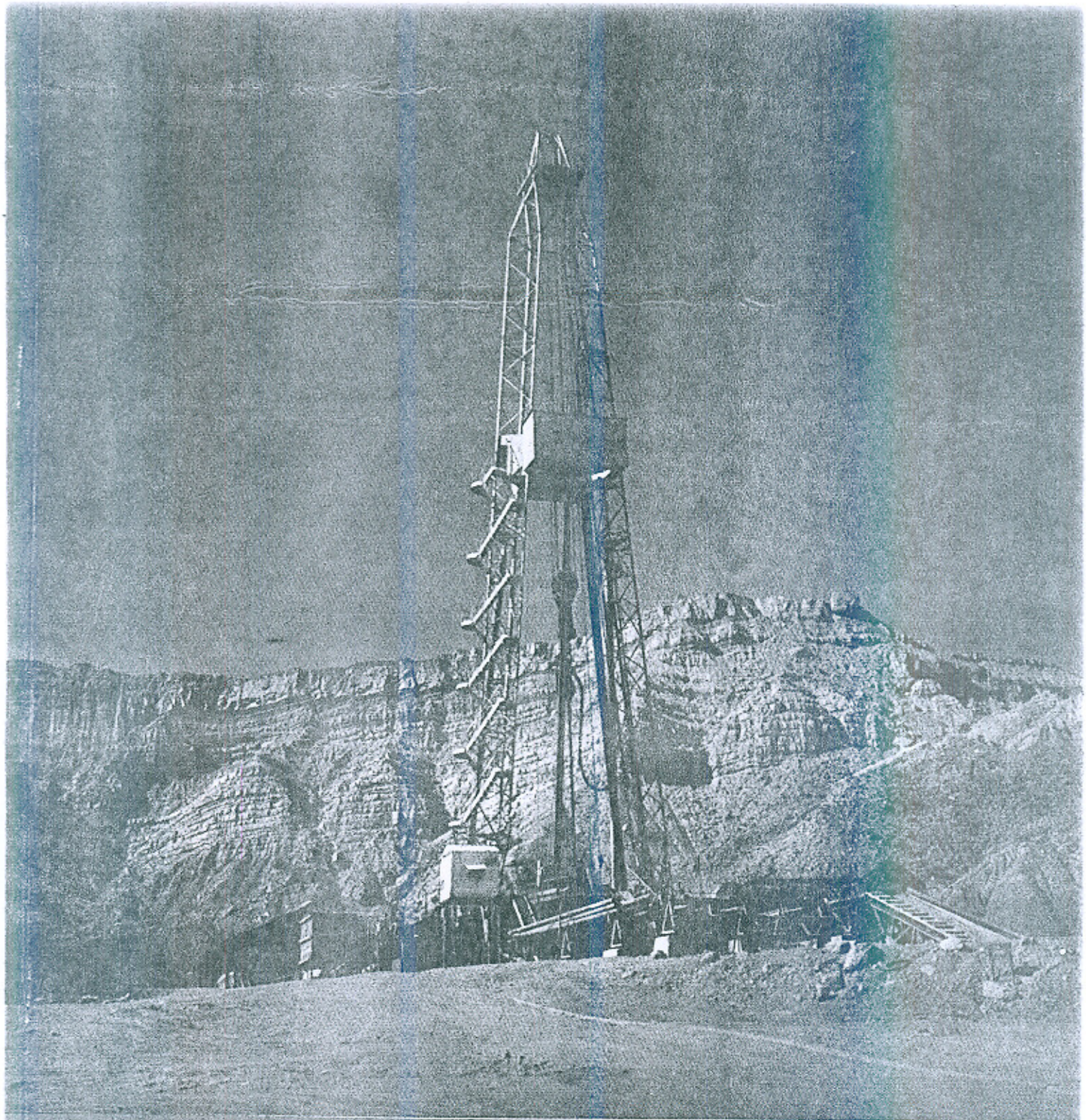

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Engineering News

A QUARTERLY JOURNAL OF WEST PAKISTAN ENGINEERING CONGRESS

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Notes

1. Consulting Engineers not listed above are requested to send their particulars to the Chief Editor "Engineering News" for publication in the next issue of the Magazine.
2. Any change in the name, address or telephone number of any firm may also be promptly notified for carrying aut corrections in the next issue.

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— Contributions to this journal in the form of technical articles, news about engineers, engineering works, research projects, with photographs etc. are cordially invited.

— When quoting from this journal, please specify volume number, date and author's name.

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In this Issue

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TITLE
A view of the first oil drilling rig at Dhodak

LIQUID GOLD

According to one estimate, 80% of the current world business by volume and 90% by value deals with Petroleum or Petroleum products. This fantastic boom in petroleum trade has come about only over the last 100 years or so although, strange as it may seem, Rock Oil (Petroleum) has been known and used in various parts of the world from pre-historic times.

The Assryians and the Babylonians used oil seepage from the lower regions of Euphrates and Tigris. Similarly, seepages were known, and used in various ways, in Messopotamia and the adjacent areas ; in Baku region of what is now the Soviet Union ; in the West Indies (Trinidad) ; and in America (Great Lakes area, oil creek and so on). Ancient oil and gas seepages, first ignited by lightning, probably harboured the secret of those eternal fires around which the cult of fire worship developed in Persia.

At the dawn of the Muslim era, the Arabs and the Persians were already familiar with the elementary distillation of crude petroleum and the usage of Kerosene as an illuminant. Later, through the Arab invasion of Spain, this technology was transported to Europe.

In the early 19th century, Kerosene (by now also distilled from natural coke) was in great demand. With the development of huge urban centres and the anticipated requirement of illuminants and fuels for the industrial revolution, frantic efforts were made to discover a new and cheaper source of supply for Kerosene.

The year was 1859, the place-Tutsville, in the oil creek region, Pennsylvania, U.S.A., where one Colonel Drake triggered off the petroleum revolution by sinking the first ever well, specifically for oil, and striking the liquid gold at a depth of only 31 metres. The romantic world of energy has never been the same again. Petroleum has been explored and consumed like nothing else ever before, or since. It is estimated that by the year 1980, almost 50% of the world energy requirements will be met by petroleum products and 18% by natural gas.

According to the International statistics collected in early seventies, there are proven oil reserves in about 60 countries of the world, out of which the Middle Eastern countries claim about 62% and the Far Eastern region, in which Pakistan is bracketed, claims only 0.21%. This, however is not the true picture of oil prospects in Pakistan, as relatively little exploratory work has been done in the reportedly large sedimentation basin in the country.

In the last 30 years, 85 wells have been drilled in Pakistan - just less than 2% of the world average density of drilling for comparative areas. In 26 of these 85 wells, the target depth was not reached and they were in that sense failures. Out of the remaining 59 there were 38 finds, including two oil and gas fields.

For the last 14 to 15 years there has been some emphasis on exploration, but relatively little on drilling. Therefore, the empirical laws have been against finding oil in the country.

Dhodak is one of the several prospective oil fields close to the Sulemanki Division. It is for the first time that oil has been found west of Indus which is a significant indication. There are, indeed, interesting possibilities for finding oil in Pakistan because all the parameters are available and the only thing we lack is the density of drilling, frequency of drilling and good luck.

There has been talk of achieving self-reliance in petroleum. However, because of a critical shortage of adequate professional base, in all categories and at all levels, and because of lack of sufficient finances, complete self-reliance in petroleum might be a myth. On the average, at present, it costs 4-5 million dollars for drilling just one well and an equivalent amount for exploration and development. It takes 3 to 7 years to develop a single oil find. These are realities that cannot be changed. The answer of course is at least partial reliance on foreign enterprise. A major problem in attracting foreign enterprise is that, for the large commercial companies, oil exploration is not considered worthwhile unless there are proven reserves of 10 billions barrels in the area. Also, it is said that benefits of oil revenues generally do not permeate to the common man, unless at least one million barrels are extracted every day. As against these figures, the present output of only a few thousand barrels per year in Pakistan seems negligible.

However, an energy starved country like Pakistan cannot really work out its priorities purely on economic considerations, as may be done by the developed countries who have a choice at hand. If Pakistan can become self-sufficient in petroleum extraction and refining, using local resources, then it might be worthwhile even at a much higher price than the world oil companies would normally consider economical.

Out of the energy sources that can compete with gas and oil, one can talk of :

— Hydro-electricity (but this cannot be a major competitor in the years ahead because most of the sites for hydro-electric power around the World are already committed to power generation)
— Nuclear energy (this can be a serious competitor but the problem of pollution and disposal of contaminated waste still remains to be adequately solved)

With the above difficulties in view and the knowledge that oil and gas reserves in the world will dwindle in the next couple of decades, serious efforts are being made all around the world for finding alternative cheap sources of energy which do not have the accompanying pollution problems. In recent times, research work on the age old methods of harnessing solar and wind energies has been intensified and efforts are also being made to utilize tidal energy.

So, while there is need in Pakistan for intensifying search for petroleum, the possibilities of making use of solar and wind energies should also be explored in right earnest.

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INTRODUCING Mr. S. M. AYOOB
THE NEW PRESIDENT OF PAKISTAN ENGINEERING CONGRESS

Syed Muhammad Ayoob has been elected as new President of Pakistan Engineering Congress.

He was born in District Muzaffar Nagar of United Provinces, India on 8.9.1924. He got his Engineering Diploma of Civil Engineering from Thomson College of Civil Engineering Roorkee, in 1944.

He joined Irrigation Branch of P.W.D. of United Provinces on 1st August, 1944 and was posted on the construction of Muhammadpur Power Station of about 10,000 K.W. capacity on the Ganges Canal alongwith all its paraphernalia.

Subsequently in July 1948 he was transferred and posted in First Sub Division of Upper Division Eastern Jumna Canal where, apart from regulation, he was incharge of several Cross-Drainage and River Training works.

He migrated to Pakistan in December, 1947 and was appointed as temporary Engineer in the Irrigation Branch of P.W.D. of Punjab. He worked in various Project Sub-Divisions and contributed in preliminary surveys, investigations, designs and preparation of various Projects.

He was appointed Assistant Executive Engineer in Punjab Service, of Engineers Class I, in July 1949.

In June 1951 he was posted as Sub-Divisional Officer Marala Headworks. He was promoted as Executive Engineer in October, 1952 and posted as Executive Engineer Marala Division, where he continued till October 1954. During his stay at Marala apart from Regulation, normal maintenance of Headworks and other ancilliary works, Remodelling of Upper Chenab Canal for a capacity of 16,000 cusecs was carried out. Remodelling of the channel section and remodelling of more than 20 bridges and drainage syphons was carried out.

From October 1954 to November 1960 he worked in various Circles, Under Secretary Government of Punjab, Technical Officer Lahore Region, Irrigation, Assistant Director Design and Research, Assistant Director Construction and Executive Engineer (O. S. D.) Water dispute in the office of Chief Engineer Irrigation, West Pakistan. From November 1960 to June 1961 he was incharge of Kot Adu Division of Taunsa Barrage System.

In June 1961, he was promoted as Superintending Engineer and posted to Quetta Irrigation Circle. From Quetta he

was transferred to Sukkur Region where he worked as Superintending Engineer Headquarters for a couple of months and then posted to Khairpur Irrigation Circle where he was having administrative control of Sukkur Barrage. During his stay in this circle a 7' fall on Rohri Canal was constructed for a designed discharge of 15,000 cusecs. Seven prestressed Concrete Bridges across Rohri Canal were also executed under his administrative control.

In August 1965, he was transferred from Sukkur and posted as Superintending Engineer, Lower Bari Doab Canal Circle where he continued upto October 1967. He put in efforts for the exploitation of ground water and got approved four Tubewells Schemes. Remodelling of Lower Bari Doab Canal for a capacity of 8,000 cusecs was also taken-up.

In 1967 Government of Pakistan selected him for an International course of Hydraulic Engineering sponsored by UNESCO in Holland. He was awarded diploma in Hydraulic Engineering Delft. His specialised course was Hydraulic structures. During his assignment in Holland, he visited Engineering Works and International famed research Organizations.

Due to his varied experiences in applied Engineering designs, and administrative fields he was appointed Director Irrigation Research Institute, Lahore in August 1969 where he infused a new life and made it a renowned Institute especially in Hydraulic field. It ranks foremost among advanced Hydraulic Research Stations in the world.

He was promoted as Chief Engineer and was appointed at Lyallpur on 27.6 72. ing incharge of Sargodha Irrigation n, he was incharge of a vast Irrigation System of the Punjab and he took keen interest in Flood Protection Works after the disasterous floods of 1973, Construction of Samundri Drainage System was accelerated and Paharang Drainage Project was planned for drainage of vast areas and protection of Lyallpur from flood ravages. He was deputed to visit Iran and Turkey for study of the Research Stations in the R.C.D. countries.

Due to his brilliant career and administrative ability the Government of Punjab selected and appointed him as Secretary to the Irrigation and Power Department. Besides Administrative Control of the biggest department of the Punjab he is taking keen interest in the running and maintenance of canals, their regulation, Flood Protection Works, proper maintenance of Barrages, control of monetary grants for all the annual works alongwith planning, design and execution of new works. During his period as Secretary most of the Scarps and Barrages completed by WAPDA and transferred to Irrigation and Power Department are being marked independently.

In February 1975, he headed a team of Engineers which visited Arab Republic of Egypt to study Drainage System evolved in that country. Recently he attended CENTO SEMINAR on Remote Sensing Multi-Disciplinary Application at Istanbul (Turkey) from 5.10.76 to 12.10.76.

The Engineering News welcomes Mr. S. M. Ayoob as new President of the Pakistan Engineering Congress. His dedication to the cause of profession is well known. Under his able guidance, the Pakistan Engineering Congress will not only maintain its cherished traditions but reach new elevations.

Papers presented at the Technical Sessions

Sr. No.	*Paper No.*	*Title*	*Name of Author*
1.	420	Problems and needs of Engineering Education in Pakistan.	**Prof. Dr. M. Islam Sheikh,** Vice-Chancellor, University of Eng. & Techonolgy, Lahore.
2.	428	Alignment and Shape of a Spur Head	**S. M. Ayoob,** Secretary, Irrigation & Power Department, Punjab, and **Ch. Mohammad Ali,** Principal Research Officer, Irrigation Research Institute Lahore.
3.	425	A Computer Program for Raft Analysis with specific reference to Wapda House Raft Foundation.	**Dr. Javed Yunas Uppal,** Dy Chief Structures NESPAK and **Dr. M. Talib Chaudhry,** Convenor, Computer Programming Committee NESPAK.
4.	422	Variation of loss with Specimen Size of Alcomax III at 50 HZ Excitation.	**Mr. Pervaiz Rashid,** Electrical Engineer, NESPAK Lahore.
5.	421	Towards Higher Productivity	**Mr. Amanullah Khan,** Managing Director, Northern Foundry and Engineering Works Ltd.
6.	426	Breakthrough in Development—an imperative for Pakistan's future.	**Imtiaz Ali Qazilbash** Managing Director, Engineers International.
7.	429	An Appraisal of Rural Electrification in Pakistan.	**Mian Fazal Ahmad,** Member United Nations Roster of Int'l Experts.
8.	427	Traffic Organization in Pakistan.	**M. Sadiq Swati,** MCP (Transport Planning, Planning Division, Islamabad)
9.	423	Selection of Hydraulic Machines for Scarp Tubewells.	**Sardar Allah Bakhsh,** Managing Director, Sabasun Technical Services and **Dr. Akmal Hussain,** Chief Mechnical & Electrical Engineer, Sabasun Technical Services.
10.	424	Economics of Mechanization with reference to earth-moving operation in Pakistan.	**S. Nisar-ul-Haque,** Managing Director (MCP).
11.	430	Some Problems of Technology Transfer.	**Masood Hassan,** Secretary, Govt. of Pakistan, Ministry of Defence.

Sr. No.	Paper No.	Title	Name of Author
12.	431	Preventive Maintenance and Replacement Strategies.	**Dr. Amjad Parvez Sheikh,** Dy. Chief Mechanical Engneering & Equipment Division, NESPAK.

Note : The discussions on the above papers are preserved on tape and will be published under a separate cover.

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Condolence Resolutions

MIRZA ABDUL LATIF

On the 26th November this year the communtity lost a dedicated, selfless social worker, the engineers an eminent colleague, and the Pakistan Engineering Congress a dynamic member who made significant contributions towards the cause of advancement of engineering profession. On that fateful day, I lost a very dear and close personal friend.

The sudden death of Mirza Abdul Latif came as a thunder bolt from a clear blue sky. His untimely departure has left a vacuum that will be felt for a long time to come.

I move that this house, the General Body of the Pakistan Engineering Congress hereby puts on record its deep sense of sorrow at the sad demise of Mirza Abdul Latif, a man whose life was motivated purely by what is desirable and noble in the human soul. I further move that a copy of this condolence resolution be sent to the bereaved family.

Moved by : M. Afzal Zaffar Seconded by : M. S. Khan, M.M. Khan and others.

MIAN IFTIKHAR-UD-DIN

Mr. Iqbal Shahab moved a resolution to condole the death of Mian Iftikhar-ud-din and the following friends who are no more with us :

1. Ch. Fazal-ur-Rehman, C.E. Irrigation
2. Sh. Mohammad Azmat-ullah, C.E. Highways
3. Syed Ejaz Hussain Shah, C.E. Irrigation
4. Mian Mohammad Saeed-ud-Din, S.E. Irrigation
5. Mian Mohammad Manzoor-ul-Haque, S.E. Irrigation
6. Mr. Zaheer Ahmad Parvaiz, S.E., P.H.E.D.
7. Mr. Mohammad Anwar Masud, XEN Irrigation
8. Mr. M. A. Rashid, XEN Irrigation
9. Sh. Nazir Ahmad, XEN Highways

FATEHA prayers were offered by the house for all the departed souls.

Highways

Suggestions on Safeguards Against Traffic Accidents on Roads

SALEEM AKHTAR BHALLI*

GENERAL

The road accidents can be controlled or atleast reduced considerably through adequate education and enforcement of the traffic laws and also better geometrics. Salient features of both the aspects are discussed in the following paragraphs. However, even if all the geometric design considerations have been fullfilled and engineering aspects accomplished with a view to eliminating the road accidents, a road does not become accident proof because it is the "person behind the wheel" who uses the road and the vehicle. Much depends on his judgement and conduct even after the required environments have been made conducive to avoid accidents and damage of life and property. A driver of a vehicle is a human being. He can be reckless and unsafe. He can be with unsound mind, vision or worried. There can be millions of reasons for the distraction of his attention from his main duty of operating the vehicle according to rules and regulations. Even if one driver is not at fault physically or mentally, still the life and property of this driver and his passengers are perpetually in danger from the other driver, who may not be of perfectly sound mind, physique and thinking. An eye opening example has been actually provided in the perfectly designed and built modern highway between Karachi and Hyderabad on which road, some of the worst head-on collisions have taken place. A notable is that of Saudi Arabia where the incidence of road accidents is compartively lowest in the world and almost negligible in volume because of the regulation that causing injury or death by an automobile is treated simply like injuring or killing a person or being with any other tool and punishment is awarded consequently in the light of the Islamic Law. There a driver, therefore, is well aware of the fact that if he causes the death of anybody else while driving his vehicle, he (the driver) will also be tried as a murderer and will receive the appropriate punishment as such.

The occurrence of accidents, as has been presented in this paper, is due to the inadequacy of the existing traffic laws and lack of the enforcement and education of the existing ones besides possible deficiency in the geometrics of the roads.

A. Education and Enforcement of Traffic Regulations.

While the defects of the bad road construction can be eliminated and successfully overcome by a good and careful driver, the failings and shortcomings of the driver

*Director, Planning and Design, Punjab Highway Department, 6-A, Canal Park, Lahore.

"***MOST*** road accidents are not "accidents" at all. They need not happen. People die on the roads because of carelessness and selfishness. If we are building better roads, we must produce better road users"

ABIDE BY THE HIGHWAY CODE AND KEEP ALIVE !

REMEMBER

—DRIVING COURTESY : Courtesy costs nothing and patience has its own reward. Drive with patience and consideration for other drivers.

—TRAFFIC SIGNS : Familiarise yourself with all traffic signs and signals and obey them.

—LIGHTS, BRAKES, STEERING and TYRES should be frequently checked. Lack of maintenance may lead to an accident.

—CHILDERN are in special danger - particularly those under five and those who cycle. Protect them and train them in road safety.

—OLD PEOPLE may react slowly. Their difficulties are increasing with the continued growth of motor traffic. Give them great consideration.

—THE BLIND also need your help. Give every consideration and assistance to a person carrying the familiar white walking stick.

—HEALTH is important. Be sure you are fit to use the roads. Make due allowance for poor eyesight, deafness and fatigue in others.

—ALCOHOL, even in quite small amounts, makes you less safe on the roads. The same applies to drugs even if taken medicinally.

—ANTICIPATE ACTION : Do not think that your mistakes alone can cause accidents. Be prepared for the "Mistakes" of others too. Try to anticipate their actions.

—PLAYING ON ROAD : Teach your children how to cross the road safely. Never let children play on or near the road. Do not allow small children to cross a road alone.

cannot be eliminated by any degree of perfection in the design, construction and maintenance of roads.

The following factors in connection with education and enforcement of traffic regulations are, therefore, worthy of cognizance. These factors are most important and need strict enforcement.

1. Exceeding the speed limit.
2. Violating the right of way.
3. Driving on wrong side of the carriageway.
4. Reckless driving.
5. Prohibition of parking on main carriageways. Parking on the shoulder or the bus-bays or lay-bye areas should be enforced.
6. Stoppage of use of narcotics and alcohol etc., as well as avoidance of driving by fatigued drivers.
7. Driver education should start from the Primary school level.
8. Drivers of heavy vehicles MUST undergo more disciplined training, stricter testing and severer examination for vision, reaction time and passing performance.
9. Stricter examinations and testing for mechanical fitness of vehicles.
10. Provision of extensive traffic signals. For a vehicle in perfect working order and normal efficient brakes, following are the minimum stopping distances depending upon perception time, brake reaction time and the braking distance. These factors are dependent upon the vehicle velocity, friction between the tyres and road surface and the driver's alertness. The stopping distances should be well posted in advance of the danger points keeping in view the following stopping distances :

Designed Speed		Stopping Distance	
MPH	Km/hour	Feet	Meters
15	24	76	23
20	32	110	34
25	40	150	46
30	48	193	59
35	56	247	75
40	64	308	94
45	72	376	115
50	80	452	138
55	88	532	162
60	96	620	189
65	104	708	216
70	112	820	250
75	120	945	285
80	128	1083	330

11. The control and check of the size and weight of the vehicle. Many of the accidents are being caused by tractor trollies which have normally a narrow size of the tractor in front and a much wider trolly or cultivating tools dangling in the air at the rear, without lights or reflectors. This type of vehicle has been introduced during the past one decade in very large numbers and rate of accidents has increased considerably due to this type of vehicle. Similarly heavily overloaded trucks are another reason for accidents besides the fact that they are loaded many times than the designed axle loads on our pavements, thereby causing pavement failure and incalculable damage to public property.
12. **Invalid vehicles :** Vehicles which become invalid should not be allowed to be left on the road and if left should be lifted by the Enforcement Staff. Many accidents are taking place due to abandoned or parked vehicles on the

main carriageways. If due to most unavoidable reasons a vehicle, due to mechanical defect or due to an accident. is left to stay on the main carriageway, then the Enforcement Authorities must ensure the provision of atleast four lamps at night and red flags during the day, around the vehicle to avoid further accidents, collision or telescopic accidents.

13. **Trees etc. along the roadways :** Certain objects on the sides of the roads frequently contribute to accidents and more than that aggravate their severity. The stronger and heavier the object, the more severe is the accident. In most of the cases when a vehicle leaves the roadway the driver does not have the ability to fully control the vehicle. Any object in or near the path of the vehicle becomes a contributing factor in the severity of the accident. Examples of such subjects are the trees, culvert head-walls, bridge abutments, utility poles, light poles and sign posts. The location of these objects in relation to the edge of the traveled lane should be controlled in the design, construction and maintenance of the road. Objects that cannot be removed entirely should be located in such a manner so as to reduce the hazard as much as practicable. Therefore, such obstructions, especially the trees must not be placed too close to the edge of a pavement. In the case of roads with limited right of way, the plantation should be restricted to the extremities of the right of way line. However, whatever the proposals, the plantation as a measure of the general land use and landscaping along the road must be approved by the highway engineer before hand, not only from the point of view of distance from the road pavement but also from the considerations of sight distance and future three dimensional growth of the trees etc. Such a step will, besides decreasing the chances of direct hit to the trees by the fast moving vehicles, help in the improvement of the visibility along the curves and even along the road formation. As the tree plantation and maintenance within the right of way of the highways is controlled by the Forest Department, this aspect can only be effectively controlled by making it obligatory upon that department to get their plantation plans approved before hand for future plantations and remove the plantations already done immediately as may be advised by the highway planners.

Trees too close to the pavement are those which restrict sight distance or are on existing or potential hazard and when cut fall on the pavement. These constitute the greatest percentage of trees requiring removal.

Besides the great loss to human life and property being caused by the hitting of the vehicles with the trees and similar other obstructions, it is a fact that stray animals, cyclists and even pedestrians shoot out of the bushes along the roads on to the main pavement and often get themselves

killed or cause death or other damage to the fast moving vehicles. The type and placing of shrubs and ornamental trees should also be restricted, therefore, to a height of 2 feet at a distance to be approved by the highway engineer. It is interesting to note that at present in some sections of the roads, no space has been left with the highway engineer for stacking of materials clear of the carriageways because of the thick plantations and even nurseries implanted by the Forest Department.

14. **Encroachments and ribbon developments :** Inspite of the fact that sufficient right of way had been acquired for the road since long it is a pity that because of the inadequacy of the law, right of way could not be protected properly. Not only ribbon developments have taken place right on the edge of the road R.O.W., thereby disturbing the clearance of the sight distances and reducing the traffic capacities as well as increasing the traffic accidents, but encroachments have also taken place within the road R.O.W. The worst is that at places of such ribbon development and encroachment, the drainage and refuse of the private property owner is disposed of on the road, which is not designed as a drain but is only designed to function and withstand dry conditions for the pavement. As a last resort the Highway Department has to raise the profile of the road in such localities or run over for by-passes of such towns, at colossal cost to public exchequer and after sacrificing considerable land, otherwise agriculturally productive. The worst is that the ribbon developer and the encroacher fast take over the highway engineer even on such improvements of raising and widening the roads and the newly built by-passes. However, necessary Law is now in the making before the Legislature and the legal inadequacies will be overcome and effective control will become possible.

B. GEOMETRIC DEFICIENCIES :

To make the suitability of the plan and profle of the highway for vehicles and drivers as nearly perfect as possible, is the key stone of modern highway design. The engineering design of roads can make certain types of accidents physically impossible and render human failings and weaknesses of lesser importance, thus obviating accidents or reducing their severity. The basic safety to road users should be designed into the highway, taking the time element into account in such a manner that a normal motorist is allowed sufficient time to cope with the driving hazards. However, a brief summary of the salient features to be followed in the geometric design and maintenance of road is as follows :

1. Roads with full control of access reduce accidents drastically. No pedestrian accidents at all can take place. This is however, dependent upon financial resource availability.
2. Directional singularity (as against two directional mixture of traffic) further reduces the accidents. Positive center separation prevents almost all head-on

or sideswipe collisions between opposing vehicles.

Provision of loading bays for trucks, auto-buses and lay-byes for cars, motor cycles and cyclists. Such facilities are being extensively provided by the Provincial Highway Department wherever dual carriageways are being added. For example the following projects :

(a) Lahore-Sheikhupura.
(b) Lahore-Gujranwala.
(c) Gujranwala-By-pass.
(d) Gujrat & Wazirabad By-passes.
(e) Kabirwala By-pass.
(f) Multan By-pass.
(g) Dual carriageway beyond Rawalpindi towards Taxila.

3. Provision of wide shoulders to reduce conflict between moving and standing vehicles. The Highway Department is providing 8 to 10 ft wide shoulders for this purpose.
4. Limiting access to a few carefully selected points to reduce collision with entering vehicles, depending upon financial resources.
5 Segregation of animals, animal-drawn vehicles and pedestrian traffic from fast moving automotive traffic. The cost of such a segregation by providing only a single lane separate pavement along our main road will be as follows :

(a) Along 1524 miles of Primary Highways. Rs. 100 Crores.
(b) Along 2437 miles of Secondary Road Rs. 154 Crores.

Evidently the implementation of the objective is beyond our present financial resources, leaving the only alternative with us of control and enforcement.

6. Proper geometric design with clear sight distances, superelevations and horizontal sight clearances. These elements are being taken care of in all new roads and improvement projects.
7. Better traffic markings on the pavement, curbs, objects and reflection spots should be adopted extensively to supplement signs and signals.
8. Provision of grade-separated intersections, roundabouts and traffic signals with proper lighting arrangements, especially in the urban areas. For these elements also the cost consideration is prohibitive.
9. Increasing of curve radii to facilitate turns. Such geometric improvements are being done by the Highway Department wherever resources are permitting, especially where new roads are being added.
10. Widening intersection approaches for greater capacity.
11. Pedestrian refuge islands in wide arterial streets. These are also being provided where funds are becoming available.
12. Right-turn median lanes, with separate turning phase for traffic signals where feasible, contribute to decrease in accidents.
13. Cylists using the carriageway along with motor vehicles and other road traffic, cause hazards and accidents for themselves and for others and impede the free flow of traffic, especially when the cycle traffic is heavy. Separate cycle tracks should, therefore, be provided during the peak hours of traffic.

Mass Movement Near Murree : A Case Study

by

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In the higher reaches of Murree mass movement frequently occurs.[1] This case study deals with the morphological effects of such movements. An attempt has been made to map main features. From the field observations and the skeleton morphological map an attempt has been made to deduce the type of movement. Laboratory analysis of the samples collected from the field is also given. The objective of the case study was to analyse one typical type of mass movement of the area. The location of the area is shown on a physio-graphical map of Murree & adjoining area (Map 1)

LOCATION AND HISTORY

The Chotta More Mass movement material crosses the Murree road twice. Once near Wagon and Bus stand (Mile 39) and then below Chotta More (Mile 34). Recently active movement of material has extended for several miles along the downstreams side of the valley (Diagram No. 1).

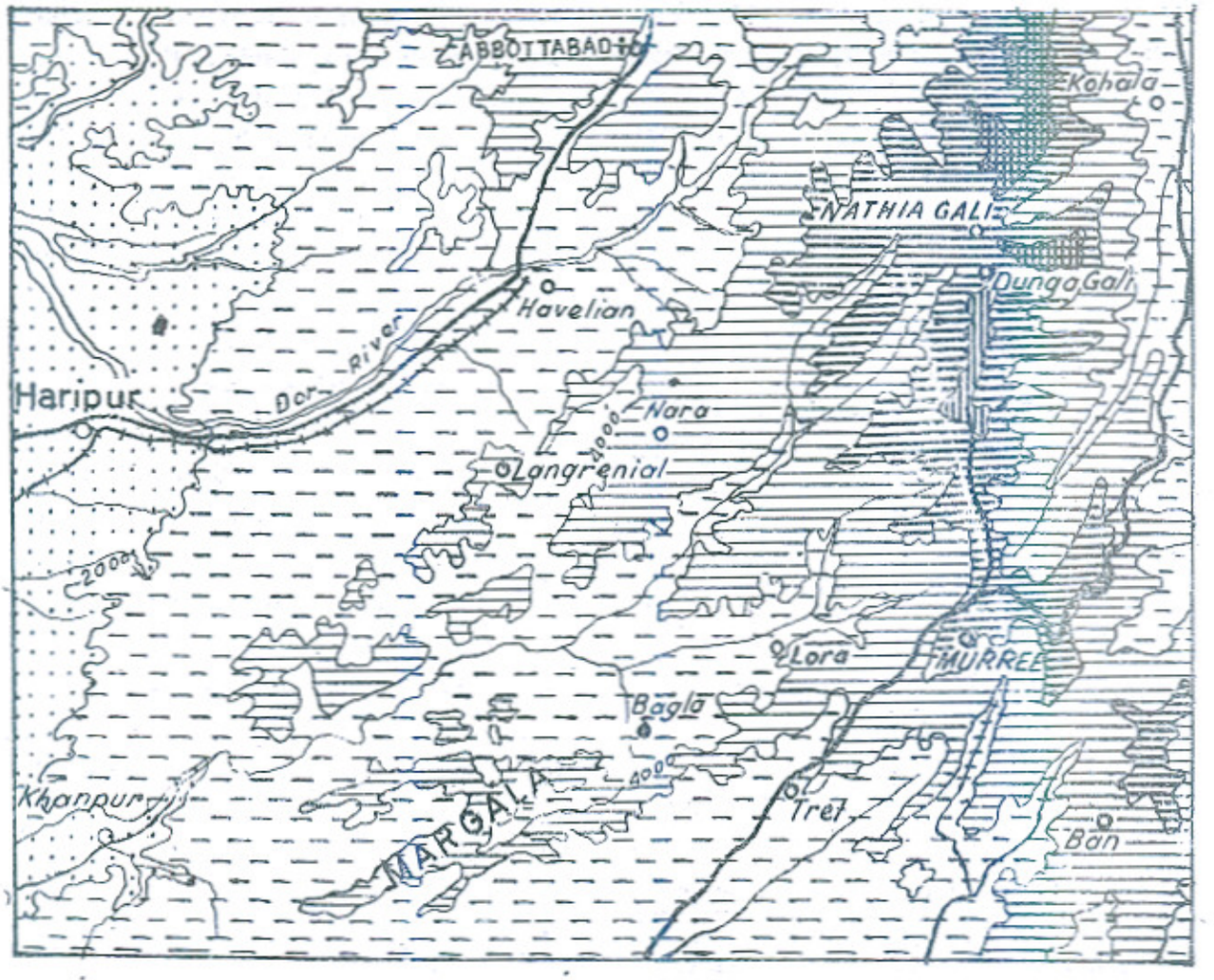
1. During the several trips and field excursions in and around Murree the problem of Mass movement was studied at several places between Murree and Tret. Visitors and local inhabitants travelling from Islamabad to Murree often observe damaged bridges, slided roads, culverts, breast walls — broken and cracked houses, slanting, curved and uprooted trees. The phenomenon acquires increasing magnitude and intensity with the increase in altitude. The field work in this area was confined to a general reconnaissance study between Tret and Murree, and later on specific attention was given to one area located near Chotta More.

The first noticeable activity at this site has been described by Wynne[2] in 1890 as land slip. The magnitude of the slip given by him was 80 to 100 yds long by 20 to 30 yds broad, and as many high. Casual observations extended over a period of 16 years starting from 1976 onwards have shown that the present mass wasting is extending both headwards and laterally. One of the largest and sudden movements noted at any time was in 1963 when several major blocks broke away from the headward cliff and moved vertically down 50 to 70 feet (diagram No. 1) Smaller material than blocks as boulders moved along the slide for several feet. Due to this sudden slumping away of solid rock the original alignment of the road which was formerly running in a straight line had to be reshaped in a curved form after blasting the cliff face and filling the edges and sides. Presently, now, the road lies about 50 ft. inside from its former location of 1960.

Since 1960 there have been periods of complete quiescent but recurring earth flows and small scale slumping have kept debris moving over the roadbed most of the time.

2. Middlemiss C.S. The Geology of Hazara and the Black Mountains Memoirs of the Geological Survey of India, Vol, XXVI, 1890, PP. 226.

PHYSIOGRAPHICAL MAP OF MURREE AND ADJOINING AREA



Map 1

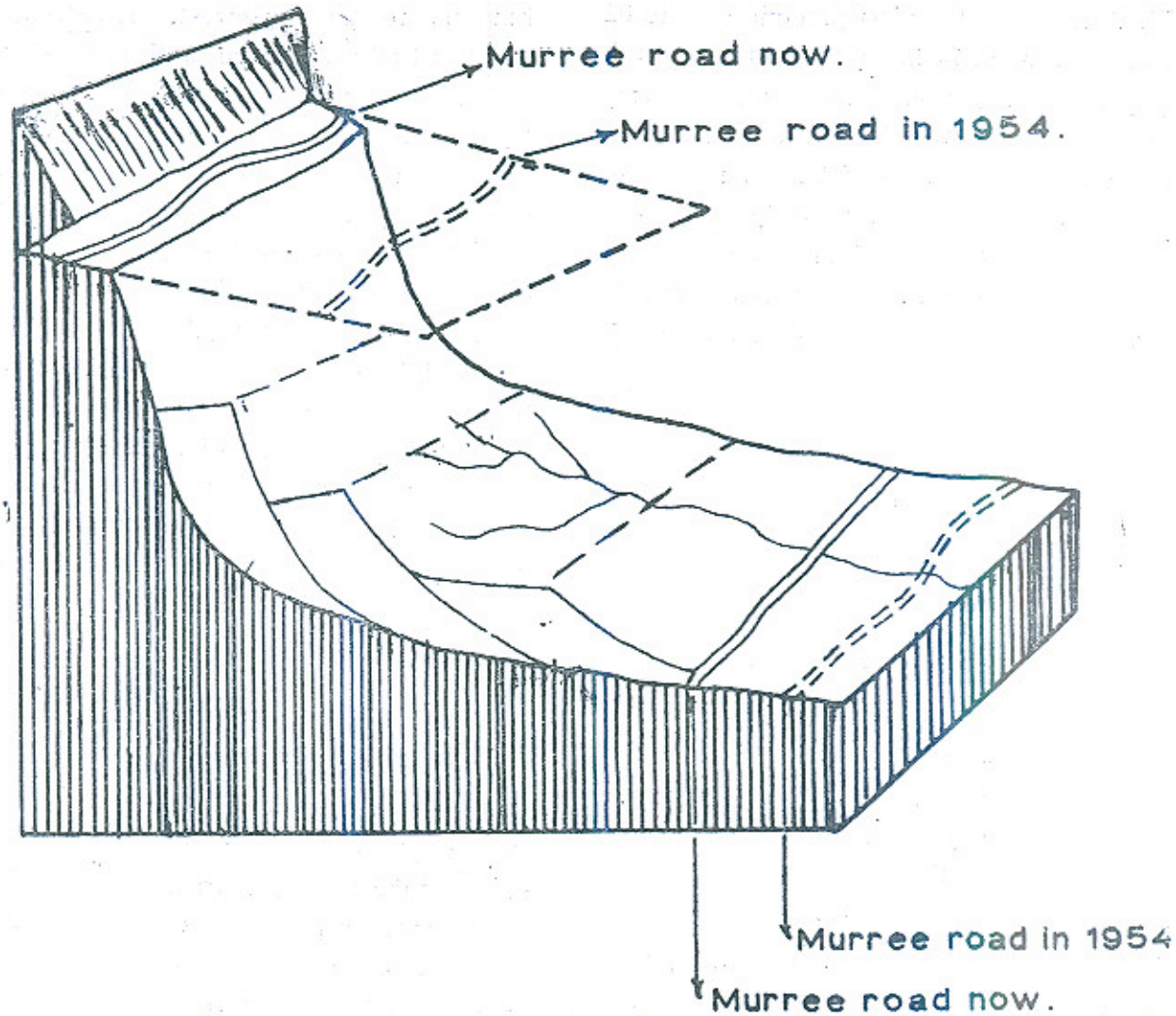
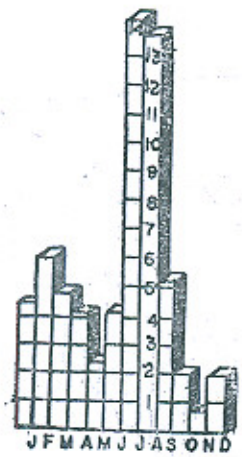

Murree road now.
Murree road in 1954.
Murree road in 1954
Murree road now.

Diagram No. 1

CLIMATE

Climatic data given here were obtained from the Meteorological Department. Mean annual precipitation is 64.57 inches with the highest ever recorded maximum and rainfall of 100.82" in 1914 and minimum 35.13" in 1920. Heaviest precipitation 10.02 inches falling in 24 hrs was recorded on 6th July 1931. Mean daily minimum temperature in January the coldest month is 30.7°F and mean maximum is 45.2°F. June being hottest month the mean daily minimum temperature is 60.5° F and mean daily maximum is 80.7°F. The mean monthly precipitation is shown in diagram No. 2



MURREE–63.71
Elev 7110ft

Diagram No. 2

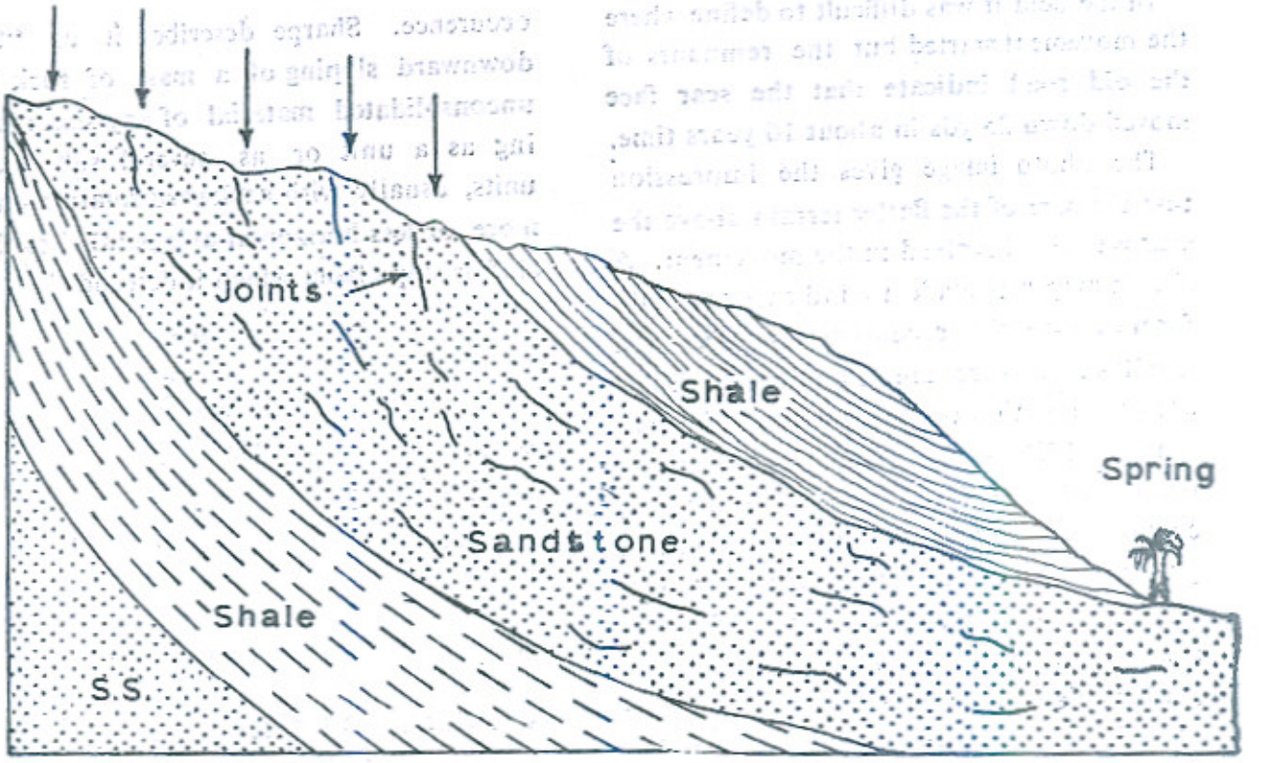
Approximately one half of the total precipitations falls during the summer months. The rainy season begins about July 1st and continues through September. Snowfall starts in December and melting starts in early March. The climate of the area effects overland flow and stream flow excessive flow during summer rains and during the snow melt season.

GEOLOGY

Geologically the ridge on which Murree lies belongs to lower member of the upper fertiaries (Miocene). Characteristic feature of the geology of the area is the steady dip of the strata down against the faulted boundry to the northwest. The strata is composed of well-bedded sandstone, which is the most prominent member, with it occur beds of deep purple shales or clay ; and pseduor clay conglomerate. The sandstone gives a long gentle dip slope to the north and scarps and secondary dip slopes to the south. The sandstone has three sets of master joints which break the rock in sequences or rectangles following the three axis of crystallography ; one set is parallel to dip, other follows the bedding plane and the third runs along strike. Shales are found alternatively interbedded with sandstone. The shale is very fine-grained consolidated mud and is almost impervious to water. Water from surface runoff after percolating through joints moves along the contact of sandstone and shale. On being saturated the shales break down readily into fine slippery clay and silt mass movement freely occurs in the area where fractures and joints admit water which converts shales into efficient lubricant and become the potential plane for slip. Weathering of shales has produced an abundant surface cover of loose materials. During rainy season the additions of water readily converts this material into moving masses.

GENERAL DESCRIPTION

The mass movement is primarily



SECTION NEAR CHARRA PANI

due to the breaking off and downward movement of large masses of shale and sandstones along the northern end of hill. The movement of rocks above 6250 foot contour is composed largely of step like blocks of sandstone and shale, which broke and moved down on a slip plane as unified masses. The lower part is composed of unconsolidated earth, clay sandstone blocks and the broken shale.

The mass movement phenomenon was not observed while in movement, but according to local inhabitants some noticeable movement occurs practically every alternate year.

The changes in the movement have been observed in aerial photographs as they are characterised by :

(a) The presence of scars and their changing positions

(b) Disruption of farming plot boundaries

(c) Washing away of houses and settlements

(d) Scantiness of vegetation

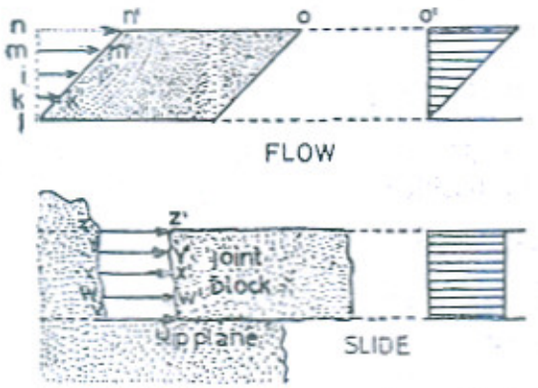
(e) The absence of the usual gray tones of the plots which have been changed into an irregular and frequent alternation of gray tones over a short distance

The aerial photographs used in this study were 1,40,000 photographs taken by Colombo Plan surveys of 1953 and Islamabad aerial photography of 1962.

In the field it was difficult to define where the movement started but the remnants of the old road indicate that the scar face moved down 25 yds in about 16 years time.

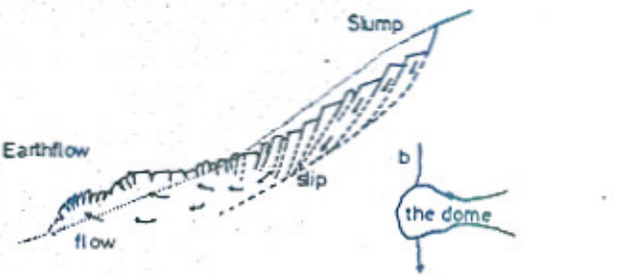
The photo image gives the impression that the part of the flatter terrain above the scar was also involved in the movement. A sketch map was made to indicate the main form to give the reconstruction of events.

Although there are a number of different classification of mass wasting, Sharpe's (Sharpe 1938, 1960) terminology which is based on the kind of material (sandstones, clay, blocks etc.), the moisture content (amount of water or ice), nature of movement (flow or slide) and the rate of movement (imperceptable, slow, rapid) has been used in this paper. Difference between flow and slide is differentiated by the following diagrams which show that :



Flow and slide movement (after Sharp 1960 .

The presence of slip surface charaterise slide, it separates the moving mass from the stable underground, while the flow type of movements do not have slip surface. Deformation is the major characteristic to be found in all parts of the moving mass. Field work has shown that slump type of movement is of common occurence. Sharpe describes it as "the downward sloping of a mass of rock or unconsolidated material of any size, moving as a unit or as several subsidiary units, usually with backward rotation on a more or less horizontal axis parallel to the cliff or slope from which it descends"



a Cross section of an earthflow (after sharp 1960).
b The bulging dome of an earthflow.

GENERAL DESCRIPTION OF CASE STUDY AREA

In the upper reaches the Chotta More mass movement material crosses the Murree road twice, once between Survey of Pakistan offices and General Bus stand and then below Chotta More (M.S.34) Recently the movement of material has extended for almost two miles along the downslope direction of the valley. Observations have shown that the present mass wasting is extending both headwards and laterally. One of the largest and sudden movements noted at any time was in 1965 when several blocks of sandstone and shale comprising millions of cubic feet of material broke away from the headward cliff and moved down for several hundred feet. Boulders, cobbles and smaller material moved along the slide for more than a mile and a half. Due to this breaking away of slide rock several houses were washed

away and the road which was formerly running in a straight line had to be shifted several feet inside. The new road now lies about 50 ft. towards cliff face from its former location of 1863. The mass movement is primarily due to the breaking off and downward movement of large masses of shale and sandstone in the headward part of the hill (M.S. 39). The removal of rock material from the hillside has formed a large cirque-like scar, and is transverse to the directions of movement. The movement of rocks above 6250 ft. contour is composed largely of slip-like blocks of sandstone and shale which moved down on a slip plane as a unified mass. About 200 yards downslope the most shocking feature is a hammock and hollow morphology, most of the forms are transverse to direction of movement. The disrupt farm boundaries have moved in the directions of the flow of material. Fan and fissure-like forms are also formed in the lower part.

A study of the development of slopes in the area indicates two distinct types of processes (i) Sporadic (catastrophic) processes characterized by a sudden start and locating only a short time (ii) Continuous processes which have worked throughout the years changing the surface created by sporadic processes.

In the upper area masses of sandstone and shales slipped along bedding plane and joints, in Sharpe's terminology may be regarded as rockslide and is clearly seen near (M.S. 39) and resulted in severe damage to road and property. Further upwards from the scar face exposed near the road slump-like movement is evident on the grassy slopes, here the intermittent movement of rock masses for short distances shows evidence of reverse slope and backward movement. In few places debris slides or soil slips in which backward rotation is not involved also occur in the area above scar face. Debris fall occurs near the scar area. Many of elongate and narrow scars of the forested slopes of Murree also indicate that debris avalanching has played a great role in shaping these features.

In the lower area debris avalanching seems to have played a significant role. Sharpe defines debris avalanche as a sort of flowing slide, it has a long and relatively narrow track and is almost invariably preceded by heavy rains which make the material lubricant and increase its weight. Movement of this material depends upon slope and the smoothness of the underlying rock surface. At times the flowage meets the stream high water contents and then advances forward in a manner similar to a typical mudflow, while the material with lesser water contents masses a debris slide.

PROPERTIES OF MASS MOVEMENT DEPOSITS

Mass-movement deposits were examined at various places representative samples of the deposit were analysed in the laboratory. The material is generally composed of weathering products of sandstone, shales but unweathered pieces and blocks are also found. On a few samples from the lower area mechanical analysis

was carried out on the fraction 2 mm by sedimentation and sieving after removing carbonates and organic matter. The percentage of $CaCO_3$ was also measured. pH was determined. The results are as follows :

Sample	Saturation%	pH of Saturation paste	CaCO3%
I	31	8.0	11.6
II	63	8.2	14.0
III	36	8.0	10.8

Histograms of the sediment analysis show high clay contents. Atterberg limits were determined using Casogrande method. The following results were obtained :

Liquid limit	30% - 35%
Plastic limit	19% - 21%
Plasticity number	about 14%

The results of clay-mineralogical analysis by D.T.A, X-ray defractometer and electron microscopy are not yet available. These results shall be reported in a separate paper.

INTERPRETATION

From the foregoing discussion it appears that mass movement seems to be facilitated by clay contents. It is to be expected that with prolonged weathering the active clay contents will increase plasticity number. Prolonged weathering favours some factors that influence the occurance of mass movement. This phenomenon, together with sparse vegetation in lower reaches, the steeper slopes and high precipitation will influence the occurence of mass movement physical setting of very steep slopes and cliffs at the edge, which is under lain largely by weak, easily weathered sandstone and shales and only indifferently covered by a protective mantle of vegetation, offers the essential passive conditions favourable to slope failure. Drainage into the slide area is the lubricating agent needed to reduce internal friction along joint or shear planes and within loose soil and rock debris, thus permitting of flowing of the materials.

A secondary factor aiding the activity of the landslide has been the unavoidable work performed in road maintenance. In the past few years, clearing away the debris that overwhelmed the tracks has removed the toe of the slide, which acted as partial support to the material above, thus leaving a considerable weight of material resting insecurely on its base of wet, slippery clay.

The corrective methods employed in the area have proved to be only temporary. The road crews keep the road open by clearing the debris from the road grade and by cutting back the adjacent slopes to low angles. These procedures do not stop the earth movements in any way : rather they tend to perpetuate the instability by leaving the unbalanced masses above the grade without support. The Forest Department attempted to grow extensive forests along the slopes, but in 1966 the entire forest growth was wiped out and did not prove an effective measure to stop the slide. Recently another measure has been taken, terraces have been constructed on contours-like fashion. It is doubtful whether the terraces would hold back the mass wasting.

Industrial Section

Utilization of Manpower The Key to Self-reliance

by

MAZHAR ALI

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1. The population of Pakistan in 1974 is approaching the seventy million mark and its estimated rate of growth is about 3.6 per cent per annum. About one fourth of the population is located in the urban areas while the great majority is rural. About half of the total are females. The estimate of the work force including females is about 40 per cent, the rest being the school age children, children before school going age and the old people. I don't hold a special brief for this statistics as a demographer. For the poor in the rural and the urban areas there is no concept of retirement - they have to work till the last breath in order to survive. And all children don't go to school for a specified minimum term - we all know why. They, in fact their parents, are not lucky enough to keep these children off from work till they have grown up past their childhood into manhood to face the harsh realities of life. For a vast number of children, childhood is as brief as the summer dawn. The matter for our consideration and for analysis is how this great reserve of human power is being deployed and being utilised. There are various guestimates of the urban and rural unemployed i.e. totally without work. But there is no dispute on the point that because of the unemployed, the under-employed, the partially employed, the shutdowns and the strikes, we lose millions of work days. Taking a rather conservative figure of 25 per cent wastage of male labour force only, we lose annually more than one billion work days. If we add to it the component of female potential work force, the figure is well above three billion mark. In terms of money, the loss is more than fifty billion rupees per annum. It is a colossal waste.

2. The question naturally arises : are we rich enough to sustain and survive the unfortunate situation? or is this the basic cause of our abject poverty and difficult economic situation? Are we oblivious of what this is leading us to? Are our thoughts clear on what is the right path to progress, prosperity and peace in the future? We have to take rather an analytical objective view of the situation, as otherwise we are getting used to live on slogans and hide our heads in sand like an ostrich. It may not be very pleasant to come back from escapism to realism but please listen to me with patience for a change. You will, otherwise, find enough people around to say sweet things to you and to proclaim that we are the greatest, the purest and the shrewdest. Lest us look at the course we are charting for ourselves. The theme of our family

planning propaganda is "Bachhe Kum, Khushal Gharana" and "Thore Boll, Sada Khushal" "تھوڑے بول صدا خوشحال" اور "بچے کم خوشحال گھرانہ". All the lectures and the propaganda songs threaten Pakistanis with economic oblivion due to population explosion. Do we really hate our people that intensely? Not that I am against planned parenthood, but the objectives have to be completely different. You can say that a glass is half empty or that it is half full. The former is a counsel of despair while the latter is a message of hope. The contrast is in the approach and in the attitude. Why should we not dissociate poverty from population density? Why should we insist on telling people again and again that their existence is an unbearable burden on the country, and that they are not an asset for the country but a liability? Is population density the cause of all ills? If that were true, Karachi with very dense population would have been the poorest, and Baluchistan with sparse population the richest part of Pakistan. Pakistan is one of the poorest countries in the world, with a per capita annual income of $ 150 at factor cost. It has a population density of 220 persons per square mile. In complete contrast, Japan has a population density of 730 (more than thrice of Pakistan) and a per capita income of $3990 eighteen times that of Pakistan. China was being told that its hungry millions were a curse and a threat to world civilization. The same population, with phenomental growth of Chinese economy after 1949, are sending down shivers down the spines of Super Powers. The Chinese labour force is 50 per cent of the population, and no body, not even the disabled, is unemployed. Chinese practise family planning extensively, but they also say that a person is born with one mouth, but two hands. Surely there are much better and healthier ways of advocating planned parenthood and a planned population growth, but it does not seem very wise to carry the "Khushal Gharana" خوشحال گھرانہ strange message to Baluchistan, Tribal areas, Tharparkar and Cholistan.

3. Yet another instance is the drive to export trained manpower to earn foreign exchange. The developed or fast developing countries who absorb all this manpower have a much higher per capita density of doctors, technicians, engineers and scientists than us. Why do they entice away our people and pay them so well when we are happy or rather proud to get rid of them? The answer is simple. These people are capable of producing far greater wealth than they consume, and for the price of their salary, they are a highly profitable and productive commodity for any nation. In the system at home, these people are knocking about from pillar to post to get a reasonable opportunity to work, to produce and to contribute to their national economy. Abroad they are sought after as mercenaries, but not as full-fledged citizens, and readily provided jobs. Where does the money come from for their rather attractive wages? Out of the wealth that they produce, in fact only a very small share of it. Were it not so, the rich developed

countries would never take them on for love's sake. This in fact is one of the devices employed by the rich nations to keep the poor nations perpetually poor and subjugated by draining away life blood of their economy and by milking away their potential to grow. It is a regular sabotage, but we at home show it up as a big success and a big foreign exchange earning device. We take great pride in a phenomenon that is deepening our economic subjugation.

4. What is our concept of an individual as a resource for the nation? It is rather vague. We are deeply influenced by the Hindu Caste System in which a race is born superior and all individuals of the superior race are the privileged and are masters of excellence by birth as compared to the individuals born in the inferior races. The Brahman was the wisest, and the Shudar the scum by birth. This social set-up excellently suited the ruling Muslim Kings, and the royalty and the nobility was presented and accepted as a class still superior to the Brahmans. They were the Sublime. The British rulers kept on and even deepened the tone. The White Man was always wiser than the black man, even the black Nawab and the black Brahman. The Hindus readily accepted the supremacy of the English because it was a part of their faith to recognise racial superiority. The Muslims believing differently had serious trouble. After the War of Independence in 1857, they got relegated to an inferior position as a race of weak minded, unintelligent people, very bad at science and mathematics, and not to hold positions of trust and responsibility. As individuals they had no merit. It took years of struggle to get out of this economic and social abyss and the damage was deep and profound. After years of battering, even the Muslims began to think the same way and started accepting the inferior position. A Hindu, they agreed, must know arithmatic as well as science and English better than a Muslim. The conflict which later developed was against the Hindus and not the Englishman, and was greatly sharpened by wide economic disparity beetween the Hindus and the Muslims as a result of considered British policy. It has taken many years of struggle and sacrices to shake off the political supremacy of the British, but we are still suffering from the hangover. A white man is still the wisest, at least for the majority of us. We involuntarily want to stand up when he enters, crave his friendship and seek his advice. We must go to him for the second opinion if not the first. We even ask him what we should think, and what we should do. In case of difference of opinion between two Pakistani experts, the white man would have the final say. We even seek his advice how we should become independent and strong. We look for advice from the captor how we should escape his captivity. Does that sound like much sense? The concept of white man's superiority got a great moral and emotional strength from Hindu caste concept in this part of the world. In Pakistan this concept of superiority by birth got another lease of life when a certain class or classes of services established themselves as the wisest, the

purest and the sublimest. They assumed the role of consience keepers and the god-fathers of the nation. The myth soon exploded and the realities of life proved quite harsh and different.

5. The role of an individual gets rather confused in the stratification of the society which we find ourselves in. People who rule with their mind are the wiser and the people who work with their hands must be ruled. The intellectual has the monopoly of wisdom. In the sharp distinction between white and blue collar, how can the dignity of labour be established ? This a a contradiction in itself. On another plane, the mill-owner must determine the policy, the priority and the production plan and the worker must bow before him or else be kicked out of the job. The landlord treats the tenant similarly as an inferior individual who earns his living due to landlord's benevolence, although the prosperity of the landlord is all due to the sweat and blood of the downtrodden creature called the tenant. In a way the attitude of the Government vis-a-vis its own employees reflects a similar tendency of treating the functionaries and the workers not as full participants in national economic struggle, but as job seekers and mercenaries, not to be coached and groomed into a team, but to be threatened and thrown about. In all these three cases, the similarity is in the position that a worker or a functionary is assigned. He is not a participant or shareholder in the production processes and development, but just a mercenary, a job seeker, an underdog who should look up to the master for his grace and benignness and for eking out a living. Surely such a relationship cannot lead to progress and national cohesion, and can not lift up a sprawling nation to face the grave challenges.

6. Before we start philosophising any further let us look at yet another aspect of employment. Wealth is generated by a worker when he is productively employed. In the national context, unproductive jobs should be minimal, and all efforts on education and training should be primarily directed to equip individuals with healthy minds and to produce better and faster. Even service institutions and security organizations should be yoked to a total national effort to produce. There must be a viable economy to be defended, and people must have the will and the capability to put up an unending and determined struggle against any aggressor. NDVP or Employment Exchange concept of employing people has serious limitations and inherent weaknesses. If jobs are there, surely individuals will fill them up—the only need is to lay down the selection/training criteria. But is that our problem ? Where are the jobs for hordes of unemployed ? Why should educated people be told after they have spent precious time and money that their B. A. (Arts) or M. A. (History) is not needed by the nation ? Whose responsibility is it to plan and to provide education, training and skills to the people so that they become useful members of the society and spearhead the struggle against poverty ? Why should teachers and professors and vice chancellors be allowed to keep their jobs while hundreds and thousands of young boys and

girls they turn out do not find their education and training of any use to them? Why should the bubbling desire of the youth to work and to produce be permanently vitiated by making them pass through long periods of torment and frustration in just seeking an opportunity to work? Does the nation not need all these young men and women to put their shoulders to the wheel and to put in a combined effort to lift the gloom of misery and poverty that presently surrounds the majority of us?

7. We have to change our concept radically. When a function or a worker is "dismissed", he loses his wages but the nation loses much too much. He was producing much more than he was getting, and then he was a proud citizen, a patriot and a defender of the country's freedom. Does the nation and the nation's pride and health remain unscathed when an individual or group of individuals get seriously mauled emotionally? Do people forget that they get excruciating pain even when they get so much as only a bump on the toe? The concept of mortgaging an individual's conscience against the fear of job security is a primitive concept, a legacy of slave and master society. There are better ways of enforcing discipline, of increasing production and of bringing out the best in the man. It is by persuasion and not coercion, of bringing in discipline by precept and not by slogans, by being true and not by deceit and cleverness. We have to be more honest and critical of our actions.

8. As a nation, we have also to define our priorities more specifically in order to persuade people to make their best contributions to the productive effort. Presently all our incentives in the society have become highly selfish, individualistic and material. What is of significance is your wealth, and your nuisance value. Higher human values are just dying out. The smuggler and the swindler is respected because of the masses of wealth around him. An inspector is socially superior to a teacher. The white collar gets much better paid and is socially better accepted than the blue collar. The air hostess gets many times the wages and many times the privileges than a nurse or a teacher. A large part of the profit is milked away by individuals working as intermediate service agents like stockists, brokers, dealers, agents, contactmen while the real worker or the producer hardly makes his living. Should we not reflect and consider whether these are our true national priorities? Can they really lead us out of the soup? Can they promote maximum national production effort?

9. We should recognise and appreciate that an oppressed labour class, group of workers or functionaries at various levels, without a feeling of participation cannot take a nation far. The master and slave concept, and the caste systems cannot withstand the great strains that are bearing down upon us. The individuals should be recognised as live, sensible creatures and should be disciplined and synthesised into a team fired by a spirit of dedication, sacrifice and hard work. Higher human values have to play a greater role and material incentives alone won't work. The political forces have all to be directed to this task of supreme national priority. Precept and not preaching alone

will help. The task is much beyond the capacity and even the imagination of the bureaucracy and the existing propaganda machinery. The challenge has to be accepted as there is no other way to survival. The face of the individual has to be lifted up, his self-respect and self-confidence restored and his ingenuity and creativity brought into full play.

10. A question arises : Where are the jobs for so many jobless or under-employed and whose responsibility is it to generate them ? We must recognise the fact that a worker always produces more than he consumes and his work makes the nation richer. The higher is his skill, the greater is his contribution. By not providing opportunities to these individuals, we are not only keeping them but also the nation poor. It may suit a group of individuals to perpetuate this condition, but surely it is not in the nation's interest. It is a failure of the system that large hordes of unemployed/under-employed exist. Under cover of NDVP and by keeping the offices and the service sector over-staffed, we do not get the best from the individual for the money paid. We do not have, and unless we strike limitless reserves of oil or find mountains of gold, will not have enough to generate enough jobs to productively employ our multi-million working force. Can we continue to gamble ? Can we wait indefinitely ? Is the time on our side ? You know the answers.

11. We have to shake off our biases and free ourselves from the mystifying haze of slogans. We have to do rethinking and replanning. We have to enunciate and pursue the policies under which we should love to work with our masses of people rather than in getting isolated. People are the real owners and the real asset and it has to be shown in letter and spirit. Brother engineers, we may have to sacrifice our sacred privileges and our leisure and demolish the castles of eliticism. If we do not join the effort, we will only be left behind. The system must find productive jobs for every individual who can work. This is his right but this is more the need of the nation. It should no longer be considered a favour to help any individual in joining the productive effort. Concept of job security must vanish. Every working individual must be provided the opportunity to work. The skills and productivity of the individuals should be constantly improved and upgraded by providing ample opportunities for on-the-job training, spare time classes, lectures, criticism, motivation and persuasion. Agriculture can absorb many times the labour force round the year if we can start intensive cultivation and plant care, intercropping, land improvement, road construction, house building, etc. The agricultural community will generate wealth not only for itself, but also more than enough for the whole nation if only they get the chance and are given their place as full partners in the struggle. Pakistan can become the land of milk and honey. Profits should depend on production and not scarcity. There should be equal pay for equal work, and chances to amass wealth without

really producing it should be eliminated. Caste system in services, between service sector and the blue collar, between khakis and the civies must cease. An individual should have all the opportunities to rise from the level of an unskilled worker to a level of the highest professional competence. Wisdom should not be the prerogative of the few.

12. Self-reliance as a nation can be achieved only by bringing out the best in an individual. It has to be recognised and shown that every member of the nation is an asset and not a liability for the country, that work by an individaul is more vital for the individual, and that opportunity to work is not a favour bestowed upon the worker. Every individual should be able to keep his/her chin up, to develop self-confidence, to be modest but firm, and to be self-respecting. A live nation does not believe in self-pity, and in looking up to others for help, consolation or encouragement. No foreign advice will ever teach us how to cultivate a spirit of dedication, discipline, sacrifice and team spirit. Economic and political freedom is won and is retained by a nation by constant struggle. Manpower is the real strength and the real resource of such a nation. It is this fountain head of perpetual national strength which uncovers and exploits other material and national resources, achieves success after success, ushers in peace and prosperity, and makes the nation grow from strength to strength. Gentlemen, are we that nation ? Are we as trained professionals, doing our best ?

General Section

Engineering Briefs

Bolan bottoms out . . .

Record flooding in north-west Pakistan resulted in the collapse of the 19m-high Bolan dam in Baluchistan.

On-the-spot reports indicate that the earth dam, completed in 1961, was totally washed away, and one report suggests that another eight minor dams were breached as flood water rushed down the Bolan valley. Emergency services were altered as water threatened the home town of prime minister Bhutto in Sind province.

Villages in the path of the tidal wave are said to have been completely destroyed, but there are no reports of casualties. Torrential rain over the past few weeks raised fears for the safety of the dam and 10,000 people were evacuated from their homes before the collapse. Army helicopters rescued workers at the site and villagers stranded on hilltops.

Bolan dam was designed and built by the Baluchistan government's Central Engineering Authority jointly with the Irrigation department, at a cost of $3.6M in 1961. The reservoir held 88.9M.m³ of water, and was an important source of irrigation water for the arid Baluchistan region. A total of 840,000m³ of earth fill went into the 500m-long dam.

The uncontrolled spillway had a design capacity of 300m³/s and it seems likely that Monday's flood exceeded the design figure leading to over-topping and collapse of the main embankment. As *NCE* went to press, there were no figures available for the flow in the river Bolan on Monday night.

Nor was there any news of a second higher dam, the Mari Bolan, also on the Bolan river. Mari Bolan, 32.9m high and impounding a similar amount of water to the Bolan dam, was built in 1958 by the Central Engineering Authority for 'irrigation and flood control'.

. . . as Tarbela tops up

Further north, widespread flooding in the Indus valley has been partly alleviated by reduced releases from Tarbela Dam.

As a result, engineers now expect Tarbela to fill for the first time next Wednesday. The level is presently being held at 2.4m below top-water level while final checks are made on instrument readings and sonar scanners map the reservoir floor for further evidence of swallow holes.

So far, according to New York consultants Tippetts-Abbett, Mc-Carthy Stratton, the instruments have behaved well, and chairman Wilson Binger was this week hoping for an early green light to top out the reservoir.

This is the third consecutive year that Tarbela has gone into the countdown stage for topping out. In 1974 and 1975 filling was interrupted by dramatic collapses, first in a diversion tunnel and then in the irrigation tunnel stilling basin. It will be a nervous week in Pakistan and New York as the water creeps up to the dam crest.

(*New Civil Engineer, London, 9 Sep. 1976*)

Threeway 'superflood' kills 300 in Sind

At least 300 people have died in Pakistan's Sind province as a result of what the government calls 'superfloods'. The inundation is the result of a triple onslaught of water from the Bolan Dam, which collapsed last week (NCE 9 Sept) killing 25, heavy rain further up the Indus in the Punjab, and an unprecedented deluge in Sind itself. The casualty figures are officially estimated; the final toll may be much higher.

The worst-hit town, Dadu, with a population of 60,000, has had 680mm of rain in 10 days compared with 37-50mm/year normally, according to Sind chief minister Ghulam Mustafa Jatoi. The key Nara Valley Drain has been breached and at one stage the town was reported to be under 1m of water.

Jatoi has stated that every kutcha (mud and wood) house in the town had collapsed and that pucca (Western-type construction) houses had been damaged. Officials reported some improvement on Friday but added that the full effect of he Baluchistan floodwaters had yet to be felt.

Other badly hit towns are Sehwan, flooded by breaches in nearby Manchar Lake which had filled to a record depth of 37m by Thursday, and Larkana, said by Pakistani sources to have suffered 'immense damage' following two breaches in the Khirthar Flood Protective Bund. In all some 50,000 people have been evacuated from 600 villages, with over 2.000 troops called in to help with rescue and emergency flood-control works.

Damage to Sind's agriculture appears extensive. First estimates put the area of ruined rice and cotton crops at 21,000ha. The inundation is reported to be worse than the devastating floods of 1973 and the entire province has been declared a disaster zone.

Unconfirmed reports from the Punjab, however, talk of 350 dead as a result of floods there, with 9,000 villages inundated, 250 houses washed away and 600,000 damaged.

Touring the stricken areas in Sind, Prime Minister Bhutto commented that the Bolan dam did not appear to have been a sound structure. Only 61m of the 500m-long dam remains, the rest having been washed away, along with several villages which are reported to have 'vanished'.

(*New Civil Engineer, 16 Sep. 1976*)

Can BSI arrest its senile decay ?

Next week the British Standards Institution holds its annual general meeting and will be celebrating 75 years of British standards. In 1901 ICE established the committee which eventually evolved into BSI, but now civil engineers are viewing the efforts of the nation's ageing standards organisation with increasing concern. This *NCE* investigation involved institutions, consulting engineers, contractors and trade associations. It reveals that, although BSI's position is largely misunderstood, only a massive shake-up plus a large injection of funds can save it from the growing suspicions of senile decay.

Signs of BSI's decay can most clearly be seen in the apparent weakness of its con-

trolling grip on the production of civil engineering codes of practice—one of the Institution's primary raisons d'etre. BSI's technical committees appear unable to produce documents of the kind industry wants ; nor avoid long publishing delays.

What civil engineering wants are codes of practice giving non-specialist engineers practical guidance on specialist subjects. Ideally the codes should be pithy, short and value for money. What the industry gets are costly and bulky 'omnibus' codes which cover too wide a field.

A good example is the draft revision of Civil Engineering Code No. 2 : *Earth Retaining Structures*, now out for comment. It covers the full range of earth-retaining structures from small gravity walls to major maritime structures. A senior partner of one consultancy has strongly recommended that the code should be broken into smaller, more logical and more useful sections.

Single-subject standards are sometimes splintered into numerous indigestible parts. BS 3680, on the measurement of liquid flow in op.n channels, now has 13 documents, each half-a-dozen pages long.

Far from being written as simple precise recommendations of good practice, codes are often published as abstract commentaries containing technical discussion, detailing the reasons behind the authors' every statement.

A code used to be advice on current good design and construction practice. Standards (or more correctly a BS specification) on the other hand, specified material quality and mandatory design criteria. The new style of code blurs the distinction between the two and this is accepted as prime evidence of BSI's enfeebled state. The institution is not strong enough to get its committees to stay within traditional guidelines for a code, which is what industry wants.

Such complex codes mean that delays are inevitable. Some codes take years to complete, and others will never be finished. *NCE* understands that between 1975 and 1976, only one of the 17 codes being prepared under BSI's Civil Engineering Code of Practice Committee (CVDP) was on schedule. Work on 11 codes had been put back by one year, four by two years and one abandoned.

BSI codes are put together by consensus of a committee drawn from interested industrial organisations, Government departments and users. With a secretary who is one of BSI's staff technical officers, the committee sits under a chairman who is either democratically elected or nominated by BSI. Finding men with the expertise, lack of bias and - perhaps most important necessary drive for the job is not easy.

A chief engineer of a major contractor who sits on several BSI committee believes that : 'Many draft codes are behind schedule because of undynamic chairmen. BSI accepts too readily its chairmen's reasons for why drafting is behind target, and I would like to see laggardly chairmen sacked'.

But nothing seems to happen to rogue chairmen or their committees beyond the occasional gentle admonishment. This could be seen as a further example of BSI's alleged inability to cope and control. BSI disagrees, and denies that senility, weak-

ness, debilitant illness or loss of vigour have anything to do with the sluggishness of pending codes.

No doubt at next week's AGM, BSI chairman Sir Frederick Warner will refute any suggestion that the institution has lost its sense of direction. He will probably state that BSI is directing itself to some purpose and give details of the corporate plan announced last year under which a degree of rationalisation and restructuring has taken place. Despite BSI's efforts to put its house in order, there is a general feeling that the problem of bad and late codes is so fundamental that it is doubtful whether it can be rectified fully.

In a nutshell, BSI is at the mercy of its technical committees - to a degree which would surprise many engineers unfamiliar with how it works.

Little can be done about the voluntary consensus system which the institution's charter and byelaws dictate for the drafting of codes, beyond a gentle chivvying.

Although it might like to, far from sacking a chairman or committee, BSI cannot even readily lay down recommendations or guidelines. There is a strict limit to what it can impose in the form of requirements on the voluntary committees it is obliged to form, claims a spokesman. Committees are left alone because BSI's byelaws do not give it the right to do much else.

Sympathetic to BSI's position, the Institution of Civil Engineers is nevertheless becoming increasingly concerned over the control of code drafting. A working party was set up last month to discuss remedies with BSI. It is likely that the Institution of Structural Engineers will become involved.

The Concrete Society is writing a report about raising the standard of BSI committees, discussing what is wrong with current operations, and including suggestions on overcoming delays. In has been suggested that codes should be produced in one year three years less than the average accepted by BSI.

BSI gives its new technical committees some advice in the form of a British Standard, BS 0 : *A standard for standards.* This contains notes for BSI committee chairmen, and for committee members, gently stressing that chairmen should remain impartial and members be ready to compromise.

BSI admits that these notes, written nearly three years ago, are now not wholly adequate. They are currently being redrafted in stronger terms and BSI is considering introducing a scheme whereby a chairman and/or his committee are appointed for a limited period. This would give the institution the option of continuing with code or not. Unfortunately problems are forcing BSI to do nothing but reflect on the scheme.

Staff officers are assigned to every technical committee to hold its hand and give advice, but even this is not as effective as it could be. BSI's construction department has 20 technical officers, each of whom is responsible for 10 to 20 codes being drafted. This, thinks BSI, is too heavy a load. Sometimes technical committees meet without a BSI representative because of pressure of work.

Even when they attend, BSI staff officers are loathe to question the decisions of the committee's experts, or to interfere with the way a code is developing. But BSI does not choose the men who sit on its committees. When the decision is made to draft a code, the institution approaches relevant organisations. Choice of the man is left to the organisations. He might be the wrong man, but he gets on the committee unvetted.

'We have to rely on the civil engineering community to provide the right people,' states a BSI spokesman. In other words civil engineering gets what it deserves.

Officially, BSI approves of the work of its committees and defends the move to more general and longer codes. 'We no longer see the distinction between a code and standard as necessary,' says a technical officer of BSI's Construction Department. 'As for omnibus codes, our committees must write what they think is proper. Civil engineering design is getting increasingly complex and we must expect its codes to follow suit.'

Privately, staff at BSI are wondering if things have not gone too far and are looking again at such items as omnibus codes. They are beginning to believe that technical discussion, comment and descriptions of complex cases should perhaps be left out of codes and published in separate text books.

Omnibus codes are now recognised as taking much too long to produce but expedition is now being given as the reason for dividing some single subject standard into separate documents.

One big standard can take too long to produce, runs the argument. Split into parts it is possible to publish a useful section before the complete standard but this approach is costly to the user.

A recent memo from an engineer to BSI expresses concern at the 'explosively increasing costs' of British Standards. He mentions the splintered BS 3680, whose 13 parts now come to £44. The omnibus three-volume CP 110 priced at £26 compared with CP 114's cost in 1969 of £1,60, and he condemns technical discussion in the codes.

BSI has also come in for criticism over its increasing membership fees. Firms used to pay a subscription based on the number of their employees. Last year BSI changed the scale, and based it on employees' pay and company turn-over.

One large group's subscription went up from £360 to £2,070. It withdrew from the institution, along-with a number of other large companies.

One answer would be to increase the numbers of technical officers but cash is a problem. Also there is not the constitutional scope. It could be argued that the committees or at least their chairmen would function better if generous expenses, or even salaries, were paid. Then BSI could exercise an employer's control.

This could only be done by a radical constitutional shake-up of BSI, and a completely new basis for its funding. BSI could start again, youthful and vigorous, with all suspicion of senility swept away.

(*New Civil Engineer, London, 14 oct. 1976*)

TETON DAM

'Political' report slams BuRec

Three months before the Chadwick panel of inquiry into the Teton dam failure is due to present its findings, an American congressman, Leo J Ryan, has launched his own attack on the dam's designers, US Bureau of Reclamation.

As chairman of the House of Representatives' government operation sub-committee, which conducted its own investigation into the June failure, Ryan last week accused BuRec of being 'blinded to the dangers and hazards' of the project, and called the collapse 'a man-made disaster'. At the same time, he admitted that the 'exact cause of the dam's collapse is not known'.

American engineers are sceptical about the value of what they see as a politically motivated report—the congressional elections are due next month. General feeling is that, while BuRec will be lucky to escape unscathed when the Chadwick panel reports in January, there is far too little technical evidence yet to justify the congressional sub-committee broadside.

BuRec is presently drafting its own point-by-point answer to the report's criticism which it expects to be sending to congressman Ryan at the end of this week. Among the points the Bureau will make is the fact that the sub-committee contained no engineers, geologists or scientists.

Bureau representatives testified before the sub-committee and, according to BuRec director of design and construction Harold Arthur, they defended charges now made in the report about proceeding with the dam in the face of warnings, and ignoring further warning signs during construction.

In particular, the Ryan sub-committee claims that the project should have been abandoned when large caverns, some of them big enough for a man to walk into, were discovered in the volcanic bedrock. Harold Arthur admits that large fissures were found in the right abutment, but claims that they were at high elevations, well removed from the failure zone, and were backfilled with mass concrete before work proceeded.

The Chadwick panel, comprised entirely of engineers, is not entering the controversy at this stage. Executive director Robert Jansen would not comment on the congressional sub-committee criticisms of BuRec except to confirm that the panel has so far found no serious deficiencies in design or construction. The panel is still examining the fissured right abutment. Holes are being drilled through the backfilled areas and down into material, described on the geological maps as 'lake bed sediments', underlying the volcanic rock.

Target depth is 300m—well below the 100m-deep grout curtain. Cores are being taken and water pressure tests applied as drilling proceeds but, with 100m to go, no unfilled voids have so far been discovered.

Alongside the drilling programme, trial trenches have been cut to allow visual inspection of the key trench and embankments material, and finite element analyses have been carried out on the embankment using stress-strain characteristics determined insitu.

In its early reports, the panel has so far

contented itself with reporting progress on the work carried out without any conclusions. Of its five original hypotheses as to the potential cause of failure (*NCE*, 29 July) four remain possible. Only the possibility of massive seepage around the end of the grout curtain has so far been eliminated by the field evidence. The four remaining possible paths of seepage are :

- through the grout curtain ;
- through the core at the core-to-rock contact in the right abutment ;
- through the core above the base of the keyway ;
- through a crack in the core.

The latest interim report, following field work on 4-6 October, hints as possible instability in the dam itself. During excavation of exploratory trenches into the remains of the embankment on the right abutment, cracks began to appear in the dam and in the words of the report 'this evidence is being carefully studied by the panel in an attempt to ascertain whether it relates to the cause of failure, or is a post-failure condition resulting from collapse of the adjoining mass'.

(New Civil Engineer, London, 21 Oct. 1976)

Scientist floats Saudi iceberg plan

Icebergs towed from Antarctica to the Red Sea could provide an economic source of fresh water for Saudi Arabia, according to a leading French polar scientist. 'And there are no technical problems to which we cannot find a solution', says Paul-Emil Victor, head of the Expedition Polaire Francaise.

Victor has spent the last 12 months developing a detailed plan for towing the icebergs, each weighing 100Mt, across the Indian ocean, and through the Gulf of Aden to the mouth of the Red Sea. There they would be chopped into manageable chunks (about 1Mt each), using heated cables and towed through the shallow Bab al Mandab straits to be moored along the Saudi coast.

Even in tropical temperatures, natural thawing of the icebergs would not be quick enough to match demand for the water, and Victor is now working on ways of speeding up formation of the fresh-water pools, by induced melting. 'That is the last of the problems to be solved', he told *NCE* on Friday 'and it should not be a difficult one'.

Victor is awaiting the go-ahead from the Saudi government to try out his plans for wrapping the giant icebergs in an insulating jacket to out down melting losses on their 8,000km journey. At an estimated towing speed of 1 knot, it will take 6-8 months for five tugs to pull the icebergs along a computerplotted route, taking advantage of prevailing currents and winds and dodging high waves.

Without protection, over half of the ice would melt en route, but Victor hopes to cut this to 20% or less by using a huge iceberg 'coddler'. An inverted canopy, made from a 50mm-thick sheet of plastic-coated felt, will be drawn under the base of each 250m-deep berg and held there by an inflated annular sausage, itself anchored to the top of the berg. A massive skirt of the same material will then be unrolled around the 3-5km perimeter, with weights holding its base 100m or more below the

water line. Steel hausers would hold the skirt to the ice.

No top protection will be needed. According to Victor, the pool forming naturally on top of the iceberg will itself limit melting. Similarly, water layers inside the skirt and bottom protection will provide their own insulation against progressive thawing.

Once the bergs reach the Gulf of Aden, the jackets will be removed and heated cables will slice them into about 100 individual pieces, each no thicker than 150m. These slices will then be tilted through 90° and floated through the Bab al Mandab straits. Inside the Red Sea, another skirt will be fixed to each berg, to separate the fresh water from the salt-water sea, and a pipeline will connect the offshore reservoirs to the mainland.

Victor claims that, with one engineering colleague, he has now developed all the technology needed to wrap an ice-berg in its protective jacket, tow it halfway across the world, and deposit it in sections in the Red Sea. All that is needed now is the money about £100M – to try it out.

The idea of using icebergs as a source of fresh water is not new. It was Victor himself who first suggested it, 15 years ago. 'After all, 99% of the fresh water in the world is in the form of ice,' he says, 'and 90% of it is in the Antarctic. It seems natural that we should look at ways of using it'.

The source has another important advantage—it is infinitely renewable. According to Dr Swithinbank of the British Antarctic Survey in Cambridge, about 1,000km³ of ice forms every year in Antarctica-and it is all free for the taking.

Victor's original concept has since been taken up in other parts of the world and plans have been drawn up for towing iceberg up to 20km long and 5km wide to Western Australia and Chile. Though the unit cost of water from these proposals is highly favourable (about one-fiftieth the cost of desalination according to Dr Swithinbank), they have so far not come to fruition because of the very high initial investment needed to develop and build the size of tug needed and the risk of failure. A scheme to tow giant icebergs to California to provide water for Los Angeles also seems to have been abandoned.

But all these schemes relied on the huge initial size of the iceberg to overcome melting losses. Losses of 50% or more were considered acceptable, because the remaining ice would still constitute a massive reservoir. Victor's plan to insulate the icebergs before their journey makes the idea economic for much smaller bergs. Existing tugs can be used for towing and the finance suddenly moves into the realms of possibility, particularly in the Middle East.

For Saudi Arabia, Victor calculates the cost of his iceberg water at 50-80 US cents/m³—well below the cost of desalination. A side benefit for the Saudis is that a line of melting icebergs 1.5km offshore would be a giant air-conditioning system, dropping local temperatures by as much as 5°C, according to Victor.

(extracted for New Civil Engineer London, 18, Nov. 1976)

*DAMS IN TROUBLE**

Tarbela Tunnels to Re-open in April

Tarbela dam's second race against time is won. Final concrete was placed in stilling basin three on 6 March, completing six months of frantic repairs to the irrigation tunnel outlet works. After 28 days for curing, outlet gates will be opened on 4 April to allow water to pass through the tunnels for the first time since August 1975.

The gates were closed on 17 August when the tunnel discharge burst through the 3m thick basin floor and gouged huge caverns out of the underlying rock. To repair the damage, contractor Tarbela Joint Venture was forced to take alarming risks with divers working below the undermined walls as tremie concrete was poured into the cavern and nine 'pillars of Hercules' were manoeuvred into position to support the walls.

Completion of the repairs means that irrigation water will now become available from the reservoir storage. Closure of the tunnels cut off all but the top 9m and this (less than a fifth of the reservoir's capacity) has been eked out to give some water to the farmers in the Indus valley during the dry winter season. Re-opening the tunnels will boost irrigation supplies during April - a month earlier than TJV predicted at the start of the repair operation.

A fifth tunnel on the left bank of the Indus is also due for completion early in April. Separate from the main contract, tunnel five has been designed and built by Pakistani national companies. It will be used when irrigation demands exceed the combined capacities of tunnels three and four.

(Repoduced from : New Civil Engineer, London, 11 March 1976)

Tarbela Tunnel Hopes Eroded Again

Tarbela dam is in trouble again. Following only 21 hours of flow spread gingerly over six days to test extensive repairs carried out last autumn, irrigation tunnels 3 and 4 have been shut down indefinitely due to significant new erosion damage in the stilling basins of both tunnel outlets.

According to contractor Tarbela Joint Venture, divers report erosion 1.5m deep at the base of the basin 3 wall and a 1.4-square hole between 150mm and 750mm deep in the dividing walls between the two basins.

Engineers at the site are reportedly alarmed and mystified by the speed at which the erosion has occurred. The damage appears to have hit the same areas of the stilling basins which were partly destroyed during last summer's emergency draw-down, despite extra strength in the repair concrete.

Following hurried consultations, the Pakistan Government has approved plans to dewater the basins again, and New York designer Tippets Abbett McCarthy Stratton has summoned its panel of 'special consultants' to attend a five-day

*NCE reports on Pakistan Tarbela Dam and USA's Teton Dam

site meeting beginning on 10 May. Meanwhile TAMS engineers are hurriedly working out whether tunnel five and the two spillways can provide enough control when the Indus begins its annual rise, later this month, to allow the affected basins to be kept out of service. It they can't and there is still some doubt the basins may have to suffer the same battering from the Indus as caused wholesable destruction of the floors and walls last August.

According to TJV, first damage was discovered in stilling basin three after a one-hour test on 21 April the first time that tunnels three and four had been opened following last year's erosion. Extensive diver surveys immediately after the test showed erosion to depth of 25mm in some floor joints. A second test, this time for two hours, on 24 April produced no evidence of further damage, but when water was released for 18 hours on 26 April, the divers surveys dismayed the engineers.

Testing was immediately halted and the Pakistan Government was told of the new emergency. Following a site meeting with Government representatives on 28 April, TJV was instructed to rebuild the recently demolished downstream cofferdam and pump out the 22m-deep basins for inspection. TAMS special consultants had a briefing session in New York on 3 May in preparation for their site visit as soon as the water level is down.

There are no theories yet as to the cause of Tarbela's latest trouble. At the request of the Pakistan Government the repaired basins were inspected by TAMS partner John Lowe III before testing began and the tests themselves were deferred for 17 days while final patching was carried out. In New York, Lowe's partner Wilson Binger said that TAMS was still trying to collect as much information as possible about the type and location of the damage, so that experts could analyse the failure.

Attention is sure to focus again on TAMS design of the stilling basin. The basin geometry came under scrutiny after last year's damage, when some experts expressed surprise that there was no provision for aerating the tunnel discharge to prevent cavitation (*NCE* 16 October 1975). But TAMS stood by the original design, and the basins were repaired to the same profile and with no aeration provisions.

Brian Appleton
New Civil Engineer, 6 May 1976

Two Tarbela Basins Dewatered Again

Two stilling basins at the trouble-plagued Tarbela dam were dewatered last week and an army of some 80 engineers, representing all parties involved in the project, began inspecting the latest erosion damage.

Irrigation tunnels 3 and 4 were shut down late last month when first tests following extensive repairs to the basins produced significant erosion (see *NCE* 6 May, p6). The damage is in the same

part of the basins which were partially destroyed last summer.

As *NCE* went to press, engineers were preparing to re-open tunnel four after completing epoxy repairs to one wall in basin four. The tunnel will provide extra control during the coming flood season. However, tunnel 3 remains closed as engineers try to determine why erosion in basin 3 is so much more severe. Divers report a 1.5m chunk carved out of basin 3 after only 21h of flow.

As a preliminary move, engineers are listing the known difference between the tunnels in the hope of finding some clues. Tunnel 3 is larger (13.25m dia compared to 11m for tunnel 4), while tunnel 4 is slightly longer, being the out side of the four curved tunnels.

Another factor being considered is whether tunnel 3 was subjected to longer exposure during flow tests. Tunnel gates were opened and closed in sequence and, because it requires about 30min to open each gate, it is possible that tunnel 3 suffered longer tests than tunnel 4.

But how the erosion occurred so quickly remains a total mystery. The lone design modification carried out during repairs was a 15.7m extension to the splitter walls which divide the duel outlets of both tunnels 3 and 4. This was reportedly done to reduce possible cavitation in the stilling basins.

NCE, 13 May 1976

'We're Humble, We're Running Scared'

Detailed inspections of stilling basin 3 at the Tarbela dam in northern Pakistan have revealed that much more serious damage occured during the 27th of test flow last month than originally thought, reports Brian Appleton from the site. About a quarter of the basin floor has been ripped out to a depth of 1.5m and 100t blocks of concrete again litter the downstream tailrace channel.

After a tense week of inspections, discussions and cabinet meetings, 80 experts from America, Europe and Pakistan agreed that tunnel 3 should not be re-opened again this year and a decision on repairs to stilling basin 3 has been deferred until engineers have had more time to analyse the cause of failure. Over the next month, hydraulics and concrete experts will be studying pictures of the damaged slabs, simulating the floor conditions in models, and also monitoring the performance of basin 4, scheduled to take full flow again this weekend.

There is already some agreement on the final sequence of failure. Engineers believe that water penetrated the lift joint at mid-depth in the concrete slab and, backed by the ram effect of the high-velocity water, literally burst the slab in two. A design change after last year's damage, adding an extra waterstop near the top of the slab, is thought to have prevented the water from escaping through construction joints and producing the build-up of pressure

which lifted the top 1.5m of concrete. Holes are now being drilled in stilling basin 4 to perforate the waterstop to provide a release for any penetrating water.

Argument is now centreing on just how water got into the joint. The panel of advisers for contractor Tarbela Joint Venture, led by American Barry Cooke, is certain that the primary cause of failure is cavitation (damage caused by suction when fast-moving water changes direction), starting at the sharp arrisses at each construction joint - simple butt joints have been used - and progressing downwards to open a path for the water to drive into the joints. Cooke's cure is to cut aeration groovers in the basin walls, to prevent cavitation.

Consultants Tippets-Abbett-McCarthy-Stratton deny that there is any cavitation damage in either basin, except as a secondary effect following failure, and have rejected aeration as a cure. TAMS partner John Lowe III firmly denies any suggestion that diagnosis of the causes of this year's damage was influenced by the outstanding insurance claim for last year. Admission of cavitation and introduction of aeration would be a significant design change and provide support to the insurers' rejection of faulty design claims amounting to more than $ 40M.

Meanwhile, tunnel 4 is due to reopen this weekend following a week's delay to permit installation of instruments to measure pressures under and over the slabs as a check on drainage efficiency. Accelerometers have also been placed to monitor vibration.

The decision to bring tunnel 4 back on stream is a calculated risk, though the extent of the gamble is being agreed on site. TAMS, advised by its five-man team of 'special consultants' believes that the risk of further damage is low. Others, particularly contractor TJV and its advisers, are concerned that the extensive damage which occurred so quickly in basin 3 may be repeated in basin 4.

The reason everyone is willing to accept the risk is that, whatever damage occurs in basin 4 in the six weeks, it will stay open, subsequent repair costs will be far outweighed by economic benefits from improved crop yields. Last year's loss of irrigation water cost Pakistan some $350M in lost crops.

But no chances are being taken that would allow damage severe enough to threaten other structures such as the tunnel outlets. In addition to the instrumentation, divers will make regular surveys to keep a close watch on floor and wall behaviour. The tunnel will be closed if serious erosion begins.

'We're humble, we're running scared" Lowe admitted this week. "We don't expect trouble in basin 4, but we didn't expect what happened in basin 3 either, and you've got to be cautious if something happens you didn't expect."

As engineering experts trailed one another around the tunnel outlets trying to put pieces of the puzzle together, the Pakistani Government has decided to launch its own investigation into the troubles, which have become a deep source of political embarrassment.

A joint committee of the senate and national assembly is to be set up to probe the cause of this year's damage, and there are reports that the Government agency running Tarbela, the Water & Power Development Authority (WAPDA) is to appoint independent consultants from Europe to give a second opinion on the TAMS' basin design.

On site, tension is building up as the Tarbela regulars, who have now been through three crises in 20 months, nervously await the next onslaught from the Indus.

New Civil Engineer, 20 May, 1976

Tarbela Patches Hold

Tarbela dam's patched up stilling basin number four has survived its first few hours Tunnel four was reopened for three hours on 29 May, and subsequent divers surveys found no signs of damage.

Latest reports were that the tunnel had been running for a further 13 hours without disturbance, but there was no indication of further inspections.

New Civil Engineer, 3 June 1976

Idaho : Abutment Seepage Preceded Collapse

Last Saturday morning the US Bureau of Reclamation's newest earth dam, the Teton in eastern Idaho, collapsed releasing torrents of water into the Teton and Snake rivers. Flood water inundated land, washed away houses and livestock and took a heavy toll in human life. As *NCE* goes to press, six people have been reported dead and 135 missing. Cost of flood damage has been put as high as $1.00M.

The dam, designed by the Bureau of Reclamation (BuRec), was built by a joint venture of Morrison - Knudsen of Boise, Idaho, and Peter Kiewit of Omaha, Nebraska. Although the 8Mm³ dam was topped out last October, work on the $70M multi-purpose contract was still going on when the collapse occurred and contractors' men, still on site, were at hand to raise the alarm when water started seeping.

Seepage was first spotted at the toe of the north-west (right) abutment last Friday afternoon when water was escaping at a rate of Im³/s. By 9 am on Saturday, the rate had doubled and at the peak about 2,000m³/s was pouring through a breach in the dam. In two hours, 150M.m³ of water passed through the dam from the 27km long reservoir, which was then only 75% full and was being filled for the first time.

According to eye-witness Fremont County Deputy Sheriff, Ted Austin, seepage incurred rapidly, until a hole 25ft in diameter on the dam face appeared.

Between 10.30 am and noon Saturday, the hole at the base climbed up the entire dam face. Suddenly the north side fell off, and water gushed through as the rupture grew. 'I never saw a cascade of water like that, it took our equipment and the power

station below, and I could see houses, cattle and caravans being swept away,' says Austin adding, 'By I pm, 100ft of water had dropped through the wall, leaving another 100ft pouring through'.

So far no reason for the collapse has been found though theories point to leakage at the right abutment. The dam itself was built to a conservative design drawn up by the BuRec which has vast experience in this type of work. The BuRec has designed hundreds of dams of all types and the Teton design with wide core of compacted clay, silt, sand, gravel and cobbles supported on compacted sand and gravel shells and with rockfill outer zones - has been well tried.

One reason for the collapse was suggested by Jack Horton, assistant secretary of the Department of the Interior, who visited the site last Sunday. In his opinion, water at the right abutment eroded the fill by passing either around the grout curtain or through a hole in curtain left undetected during construction.

This view is partly supported by BuRec engineers.

Leakage via the abutment seems to be the most likely explanation, but seepage pressures of the necessary magnitude suggest open voiding somewhere in the abutment or foundations. While the BuRec admits that foundation geology is complex, only three of the 15 to 20 boreholes were drilled in the right abutment. These holes were 76-91m deep and their records reveal shallow alluvium overlying 'rhyolite (or welded tuff), slightly vesicular and lightly fractured.'

The dam core was notched into the abutment with a key trench up to 21m deep and 9m wide at the base. Three rows of grout holes up to 90m deep were sunk. In the outer row, holes were spaced at 6m centres and the inner row at 3m centres.

On the extreme right of the dam crest, a borehole recorded a highly fractured zone about 60m down. According to BuRec engineers, 'recovered core consisted mostly of gravel-size fragments many of which can be crumbled in the hand - very poor recovery.' More puzzling for the BuRec are the left abutment boreholes on the line of the outlet works tunnel where in one 165m deep hole beneath the volcanic rocks, and gravel cobbles and boulders very poor core recovery' was recorded. Similar material was found interlayered between basalt and rhyolite in the valley bottom at a depth of 38-45m in a layer 3-6m thick.

Grouting was caried out through the basalt and alluvium into the underlying rhyolite. Geologically it seems as though recent volcanic basalt overflowed alluvial sand and gravel in a pre-existing river channel carved in the volcanic rhyolite base rock.

While the BuRec searches for reasons behind the first major failure in its history it will soon be called to explain the collapse publicly. The state government has authorised an independent inquiry.

New Civil Engineer, 10 June 1976

Teton report will be far from conclusive

In two weeks time, the independent panel of inquiry investigating the sudden failure of the US Bureau of Reclamation's Teton dam in Idaho will present its final report to the Secretary of the Interior and the Governor of Idaho. The report will not be conclusive. The nine-man panel, led by Wallace L Chadwick and including America's leading experts in dam design and foundation engineering, has been unable to pinpoint what triggered the collapse of the 100m-high earthfill dam at 11.57am on 5 June leading to 11 deaths and 6400M worth of flood damage.

After six months of detailed analysis and $2M site investigation, the Chadwick panel has eliminated only one of its five original hypotheses of failure. Examination of the right abutment rock, supported by cores drilled into what was left of the hillside and the rock foundation, has ruled out massive seepage under or round the grout curtain. That leaves grout curtain failure ; piping along the core to rock contact ; hydraulic fracture of the core material in the key trench ; or shearing of the core due to differential settlement as possible sources of the jet of water which ripped the dam apart.

In recent weeks, site tests have produced startling evidence about the properties of the silty core material, which appears to support the hydraulic fracture theory. Holes drilled down through the dam to the key trench on the undamaged left abutment have been water-tested to failure. According to BuRec's project construction engineer, Robby Robison, total water loss, indicating fracture of the core material, occurred consistently at water depths of about 21m - only a quarter of the full reservoir head, and about half the head at the point at which the dam sprang its first leak.

Taken at face value, the test results appear to suggest that the core material was too weak to withstand the hydraulic load from the reservoir, and was bound to fail if enough of the reservoir head was transmitted to it. Given the very open nature of the rhyolite tuff on the right abutment, transmission of the full reservoir head to the upstream side of the key trench was virtually certain.

If the water pressure did burst through the core material in the key trench, it could escape either through the open rock on the downstream side or along the wall of the trench and the core-to rock contact, then out through the shoulder of the dam. Either route would be liable to produce piping in the core material and a failure consistent with observations on the right abutment.

Protagonists of the hydraulic fracture theory point to the relatively narrow key trench (9m wide at the base and 21.3m deep with 0.5 : 1 side slopes) as a possible cause of low intergranular stresses in the site. The mass of the core would, they argue, tend to arch over the top of the trench, reducing the applied stress and making the material more liable to fracture.

Sceptics point out that the implied failure pattern does not explain the appearance of the first major leak at the toe of the dam (below the lowest key trench level), and that pouring water into a drill hole is not a reliable indicator of the performance of a dam core. Soils experts regard the test as a particularly severe one, and prone to error because of disturbance of the core during drilling.

'Drill a hole into any dam core and you will get total water loss well below the design head ; I would ignore it,' commented one US soils engineer told of the Teton results.

Further tests are planned before anyone will go firm on the hydraulic fracture theory. When the Teton site reopens in the spring, the second inquiry team - a federal review group led by the Interior Department's Deputy Assistant Secretary for Land and Water Resources, Dennis Sachs, - will commission adits into the left abutment key trench, so that undisturbed samples of the core material can be taken for laboratory analysis. And a three-dimensional finite-element analysis will be used to predict the most likely failure pattern.

One member of the federal review group with a keen interest in getting a definitive answer from the Teton investigations is Harold Arthur, BuRec's director of design and construction, with overall responsibility for all the bureau's dams. Teton is the first dam failure in BuRec's 74-year history and Arthur is fighting hard to protect the Bureau's reputation against charges of complacency and design inadequacies.

'I can defend everything about the design of this dam based on past experience,' he claimed earlier this month. He points out that BuRec has built higher earth dams than Teton, has built dams on similar foundations and with worse geological conditions, and has built at least 15 dams with similar core material.

A great deal of attention has been paid to the low plastic silt used to form the dam core. The very fine wind-blown particles of volcanic origin, which were the only material available, are typical of the soil throughout eastern Idaho ('It raises good potatoes, but it doesn't build a good dam,' says Robby Robison). Compacted to an average of 98% standard Proctor density at a moisture content 1.5% below optimum, the material has a permeability of about 10^{8}m/s.

Concern that its low plasticity produces a core that is too brittle to accommodate differential movement is discouraged by Harold Arthur. 'Dams in Nebrassa and Kansas have similar cores performing satisfactorily,' he claims, and points to Palsades dam in Idaho as a directly comparable structure to Teton. Palisades dam is on the Snake rivers, not far from Teton. The 82m-high dam was completed in 1957 with a similar design to Teton (but without a key trench) and with the same core material. It has given no trouble.

The only novel feature about Teton is the key trench. It was introduced in the higher elevations of each abutment, when pre-contract grouting trials showed that,

while it would be possible to seal the highly permeable rock by grouting, it would be prohibitively expensive. So BuRec opted for a 21.3m-deep 'V' trench down to sounder rock. Grouting was carried out from the trench bottom, and joints and cracks in the steeply sloping sides were gravity-filled with slurry or filled with hand-rammed zone 1 material.

Harold Arthur admits that the bureau designers did not consider possible arching of the core over the trench, though he now accepts it as a possibility. 'In view of what has happened, we will have to consider it in future.' With hindsight, Arthur also believes that it would have been prudent to have transition and drainage zones on the downstream side of the key trench to prevent piping.

He does not believe that any of the theories yet put forward, or any of the bureau's own investigations, fully explains what happened at Teton.

'Our analysis has found no reason why the dam should have failed,' he claimed last week: 'It may have been a unique combination of things that we have not yet identified, but I don't think that these inquiries are heading for a definitive conclusion'.

Until some conclusion is reached, no decision can be taken about whether the dam should be rebuilt. That decision will rest partly on whether the 6M.m^2 remnant can be reused (if the key trench is condemned, everything will have to be removed) and partly on political reactions in Idaho. A straw poll conducted by a local magazine revealed a surprising 55% of residents in the flood plain in favour of rebuilding the dam, though, less surprisingly, 68% favoured another site.

Brian Appleton

New Civil Engineer, 16 Dec. 1976

Member's Directory 1977

Dear Member,

The Member's Directory of the Pakistan Engineering Congress for the year 1977 is being compiled now. To make sure that your particulars are correctly recorded, please send in the following information to the Congress office without delay.

Name_____(with qualifications)

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Present Address_____

Permanent Postal Address_____

Telephone Number (if any)_____

Incharge Member's Directory
Pakistan Engineering Congress
Irrigation Secretariat, Lahore

AH MIRZA ABDUL LATIF

Mirza Abdul Latif is no more. God has taken him away. The memory lingers and, in this memory, he will live for ever.

An Engineer by profession, a scholar by choice, and a social worker by habit, Mirza Latif was motivated by the noblest ideals of service. The Engineering profession in particular owes him a debt of gratitude for his tireless, selfless services rendered at the cost of his own health.

Over the years, Mirza Latif literally wasted himself working for others. It had become a habit with him to spend long evenings after office hours to do other people's work. He wrote letters, reports, editorials and technical papers that were presented, read or published in other people's names. He never really cared who got the credit so long as he was satisfied that a good job was done.

His educational career was straight and distinctive. Matric, Islamia High School Jullundhur 1945. Graduation, Government College, Lyallpur 1949 (Ist in the province for Physics/Maths combination) ; B.Sc. (Civil Eng. Punjab College of Engineering and Technology, 1952, with honours).

His professional career followed the familiar path. Assistant Engineer, B & R 1952 ; Assistant Executive Engineer Irrigation 1954 ; Executive Engineer 1958, whence he got a special assignment as Secretary, Land and Power Development Board in 1965, in the rank of Superintending Engineer (his work involving planning, design and operation of waterlogging and salinity control projects). Upto September, 1972, he was serving as Deputy Secretary, Water and Power Department, when his special talent was recognised and rewarded. He was given a challenging assignment to organise People's Works Programme with the rank and status of a Joint Secretary in the Central Government. Later on, his services were transferred to the Evacuee Trust Board.

To his dying day Mirza remained faithful to his ideals of service. He expired on duty on 26-11-1976 in the middle of a seminar on Social Welfare sponsored and organised by the Central Ministry of Social Welfare.

He died at the early age of 46 leaving behind a widow, three daughters and countless admirers and friends, ever to mourn his loss.

CODE OF ETHICS

PAKISTAN ENGINEERING CONGRESS

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

In the name of God, the Beneficent, the Merciful.

WHEREAS Allah enjoineth upon his men to faithfully observe their trusts and their covenants ;

that the practice and profession of engineering is a sacred trust entrusted to those whom Nature in its magnificent bounty has endowed with this skill and knowledge ;

that every member of the profession shall appreciate and shall have knowledge as to what constitutes this trust and covenant, and

that a set of dynamic principles derived from the Holy Quran shall guide his conduct in applying his knowledge for the benefit of society.

Now, therefore, the following Code of Ethics is promulgated. It shall be incumbent upon the members of the Pakistan Engineering Congress to subscribe to it individually and collectively to uphold the honour and dignity of the engineering profession :

۱۔ اِنَّ اللّٰهَ يَاْمُرُكُمْ اَنْ تُؤَدُّوا الْاَمٰنٰتِ اِلٰٓى اَهْلِهَا ۙ وَاِذَا حَكَمْتُمْ بَيْنَ النَّاسِ اَنْ تَحْكُمُوْا بِالْعَدْلِ ۭ اِنَّ اللّٰهَ نِعِمَّا يَعِظُكُمْ بِهٖ ۭ

"Allah commands you to render back your trusts to those to whom they are due, and that when you judge between people, you judge with justice. Allah admonishes you with what is excellent". iv : 58

1. You shall be honest, faithful and just, and shall not act in any manner derogatory to the honour, integrity or dignity of the engineering profession.

۲۔ اَوْفُوا الْكَيْلَ وَالْمِيْزَانَ بِالْقِسْطِ وَلَا تَبْخَسُوا النَّاسَ اَشْيَاۗءَهُمْ وَلَا تَعْثَوْا فِي الْاَرْضِ مُفْسِدِيْنَ ○

"Give full measure and weight justly and defraud not men of their things, and act not corruptly in the land making mischief". xi : 85

2. You shall use your knowledge and skill of engineering for human welfare, and render professional service and advice which reflects your best professional judgment.

۳۔ وَلَا يَجْرِمَنَّكُمْ شَنَاٰنُ قَوْمٍ عَلٰٓى اَلَّا تَعْدِلُوْا ۭ اِعْدِلُوْا ۣ هُوَ اَقْرَبُ لِلتَّقْوٰى ۡ

"And let not hatred of a people incite you not to act equitably. Be just ; that is nearer to observance of duty". v : 8

3. You shall not injure maliciously, directly or indirectly, the reputation or employment of another Engineer, nor shall you fail to act equitably while performing professional duty.

۴۔ اَوْفُوْا بِالْعُقُوْدِ ۝

"Fulfil the obligations". v : 1

4. You shall faithfully observe and fulfil all your obligations.

٥- وَلَا تَأْكُلُوٓا أَمْوَالَكُم بَيْنَكُم بِالْبَاطِلِ وَتُدْلُوا بِهَا
إِلَى الْحُكَّامِ لِتَأْكُلُوا فَرِيقًا مِّنْ أَمْوَالِ النَّاسِ
بِالْإِثْمِ وَأَنتُمْ تَعْلَمُونَ ۝

"And swallow not up your property among yourselves by false means, nor seek to gain access thereby to the judges, so that you may swallow up a part of the property of men wrongfully while you know". ii : 188

5. You shall not abuse your position or power, nor accept illegal gratification of any sort.

٦- وَقُولُوا قَوْلًا سَدِيدًا ۝

"And speak straight words." xxxiii : 70

6. You shall express your opinion on engineering or other matters in a frank, open and straightforward manner.

٧- اجْتَنِبُوا كَثِيرًا مِّنَ الظَّنِّ إِنَّ بَعْضَ الظَّنِّ إِثْمٌ
وَلَا تَجَسَّسُوا وَلَا يَغْتَب بَّعْضُكُم بَعْضًا

"Avoid most of suspicion for surely suspicion in some cases is sin; and spy not nor let some of you backbite others". xlix : 12

7. You shall not criticise another engineer's work without his knowledge, nor malign, or injure his professional reputation.

٨- وَلَا تَقْفُ مَا لَيْسَ لَكَ بِهِ عِلْمٌ ۚ إِنَّ السَّمْعَ
وَالْبَصَرَ وَالْفُؤَادَ كُلُّ أُولَٰئِكَ كَانَ عَنْهُ
مَسْئُولًا ۝

"And follow not that of which thou hast no knowledge. Surely the hearing and the sight and the heart, of all these it will be asked." xvii : 36

8. Your professional advice shall be based on full knowledge of the facts and honest conviction, and you shall not write articles or advertise in self-laudatory language or in any manner derogatory to the dignity of the profession.

٩- وَتَعَاوَنُوا عَلَى الْبِرِّ وَالتَّقْوَىٰ ۖ وَلَا تَعَاوَنُوا
عَلَى الْإِثْمِ وَالْعُدْوَانِ ۖ وَاتَّقُوا اللَّهَ

"And help one another in righteousness and piety, and help not one another in sin and aggression and keep your duty to God." v ; 2

9. You shall help one another in upholding and doing what is right, and shall not associate with those who transgress and those who indulge in unethical practices.

١٠- وَأَمْرُهُمْ شُورَىٰ بَيْنَهُمْ ۖ

"And whose affairs are decided by counsel among themselves." xlii : 38

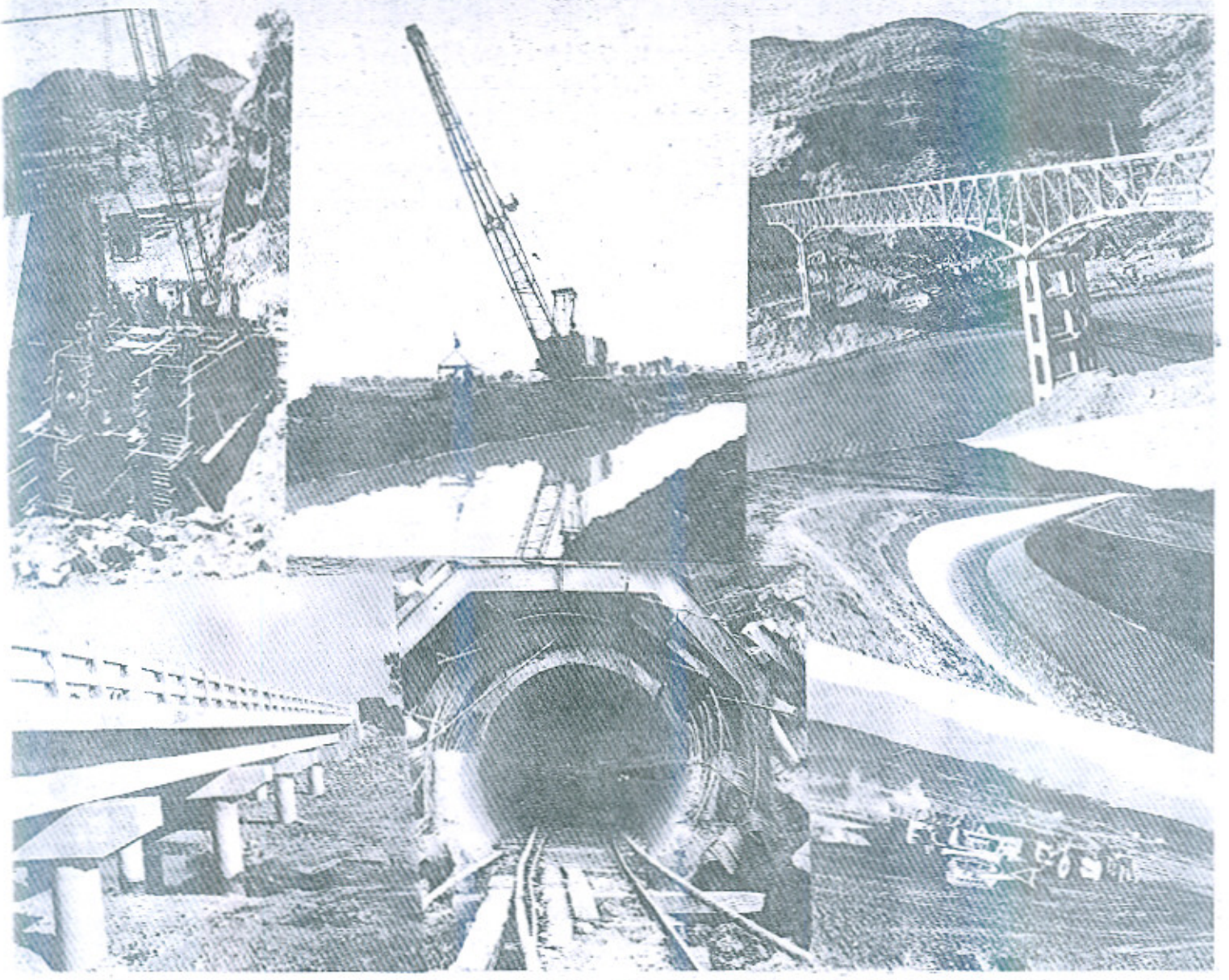
10. You shall decide matters of common professional interest by mutual consultation.

١١- وَاعْتَصِمُوا بِحَبْلِ اللَّهِ جَمِيعًا وَلَا تَفَرَّقُوا

"And hold fast by the covenant of God all together and be not disunited." iii : 102

11. You shall strive individually and collectively to enhance the prestige of the engineering profession by ordering your conduct in accordance with this Code of Ethics, and shall not be disunited.

WE BUILD



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