MINUTES OF PROCEEDINGS

of the

Punjab Engineering Congress,

LAHORE,

1934.

VOLUME XXII

EDITED BY
MEMBERS OF THE COUNCIL.

LAHORE:
PRINTED AT THE "CIVIL & MILITARY GAZETTE" LTD.,
BY E. G. TILT, MANAGER.

1934.

The Punjab Engineering Congress as a body does not hold itself responsible for the opinions expressed in this volume.

To ensure the punctual delivery of Proceedings of the Congress and of other communications it is essential that every change of address should be notified without delay to—

The Hony. Secretary,
Punjab Engineering Congress,
P. W. D. Secretariat,
Lahore.

Punjab Engineering Congress.

(ESTABLISHED 1912.)

(REGISTERED 1922.)

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Errata.

Page 32.

Line 3 from bottom *read* 2·0′ *for* 3·0′.

Page 81.

Against item 4, column 3, (Ultimate Strength) *read* 29·5 *for* 29-5

Page 84.

Column 4 of the comparative statement against Petrol *read* ¼ gal. *for* 1 gal. and against column 6 *read* 12·06 *for* 13·78.

Page 88.

Under heading Tension

read	1·42	*for*	1/42
	1·78	*for*	1/78
	2·13	*for*	2/13
	2·85	*for*	2/85
	3·56	*for*	3/56
	4·27	*for*	4/27

Page 89.

Under heading Design of Welded Joints in line 6 *read* flat *for* fla.

Page 90.

In 2nd line from above *read* side *for* hide.

Under para. (*b*) *read*

$$(a_1 \times L_1) : (a_2 \times L_2) = g_2 : g_1$$

for

$$(a_1 \times L_2) : (a_2 \times L_2) = g_1 : g_1$$

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ADDRESS

OF

Lt.-Col. W. Macrae, R.E.,

PRESIDENT.

GENTLEMEN,

It is my privilege, on your behalf, to welcome the Sardar Sir Jogindra Singh, Minister for Agriculture, Punjab, who has kindly consented to open this Annual Congress of Engineers of the Punjab and Northern India, and to welcome too our other distinguished guests.

Government have long supported and assisted us by counting the attendance of officials at our Annual Congress as " on duty."

On your behalf I can assure our guests that their presence is a personal encouragement to us to continue our efforts to promote the objects of this Society.

This era of financial stringency does not permit many large engineering projects to be taken in hand. It is an era of consolidation in its engineering aspect, a period for devising improvements in the efficiency of the maintenance of our works and for scrutinising projects, a time when the objects of this Congress are of particular importance.

In the address, which it is customary for the President of the Punjab Engineering Congress to deliver on this occasion, prior to the opening of the Congress, I therefore review the objects of this Society and the advantages obtained from promoting them efficiently.

The Memorandum of Association lays down the objects in broad lines, to promote the science and practice of engineering, and to afford members the opportunity for meeting at least once a year to discuss matters of engineering interest and to enjoy social intercourse.

The latter object is dealt with by arranging an annual dinner, and, on behalf of the Council, I hope as many members as possible will attend to attain this object.

The primary object is the pooling of engineering knowledge. When large constructions are in hand, each engineering branch tends to be pre-occupied with its own special technical problems. But when efficiency of maintenance is the chief pre-occupation, the value of knowledge of the methods of other engineering branches and of co-operation is manifest, and this Society provides the best means of attaining these aims.

The principal method of accomplishing our main object is by the submission of papers and their discussion, and in this we have at times been helped by non-members, as in the case of the very interesting 1930

paper by two members of the Indian Forest Service on erosion in the Punjab Himalayas and its probable effect on water supplies, a paper that brought forcibly to the notice of engineers of all branches the harmful effect of forest denudation on the flow off of rain and consequently on their engineering works.

The public discussion of papers in itself helps to fulfil the objects of this Congress in more than one way.

Some time ago I read the report of a very interesting discussion in America by an Engineering Society—I think it was that of the American Civil Engineers—in which it was generally agreed that an engineer should be able to state his facts, reasons, and conclusions in such a way that a non-technical man can follow him clearly, apart from check of their technical basis ; in fact, that his arguments should be as sound and convincing as his technical calculations, and the conclusion arrived at was that this ability is best attained by public discussion.

Our Annual Congress gives young engineers the opportunity of this practice ; most of us tend to feel confused when we first try to speak before a large audience ; it is hoped that young engineers who feel they can contribute points to a discussion will try to overcome their bashfulness and give the whole Congress the benefit of their ideas or of their experience, stating their points concisely and clearly in every way, not only in their wording but so as to reach the whole audience including the back rows.

Our proceedings here often show one the help that can be obtained from another branch. Various instances of this help in my own case come to mind, of which I mention the most important ; through Congress associations and discussions I heard of the Bhakra Dam, the report on its probable effect, and the valuable information contained in that report.

Most of you are aware that one of the two authors of this valuable report, Mr. H. W. Nicholson, C.I.E., has long been an enthusiastic supporter of this Congress, his contributions to discussions being very helpful and valuable.

Engineers of most branches—Irrigation, Railway, and Roads and Buildings—are concerned with the vagaries of rivers and methods of training rivers and nallahs to suit their works in this land of the five rivers.

Since 1903 when the Railway Board published Sir Francis Spring's Technical Paper "River Training and Control on the Guide Bank System," describing J. R. Bell's system of armoured guide bunds and aprons of pitching stone that drop to counteract scour, giving plans and short histories of Railway and Irrigation training works, mostly in the Punjab, the most valuable and important contribution to the study of river regimen and particularly of the vagaries of Punjab rivers is, I venture to state, the Report of the Committee of Superintending Engineers from Bombay and the Punjab, on the probable effects of the Bhakra Dam scheme on the inundation canals of the Indus between Mithankot and Sukkur.

This report arranges the immense volume of all recorded data of gauge levels, discharges, etc., of the Punjab rivers so that one can clearly see what has happened to river regimen after the erection of works affecting them ; one thus obtains a sound basis to forecast the effect of a new work and to diagnose the causes of river changes affecting existing works.

Study of this report incidentally shows up the need of a supplement to Spring's book to furnish up-to-date plans and short histories of important river training works in the Punjab, both Irrigation and Railway works, to show the various means adopted to combat river attacks on them, and collaboration between these two engineering branches would produce the more valuable reference book.

The need of a supplement to Spring's book became very apparent to me from a visit to a recently constructed weir where I was shown the plan of the river training works and of the Sutlej attack behind and on the right Bell bund, and the method of dealing with this attack. The North Western Railway has had many attacks on Bell bunds of an almost identical nature, which have been dealt with in various ways, including two in 1933 now being dealt with, one by the Sutlej behind the left Bell Bund at Gidarpindi, and the other by the Jumna behind the right Bell Bund at Kalanaur as a change over from its former attacks behind the left Bell Bund. Obviously both engineering branches would have derived great help from a reference book giving clearly the history of former similar river attacks on training works.

In the past, Congress visits by train to important works were regularly arranged and with regret these were given up till more prosperous times, for the Council felt the time inappropriate for asking the grant of travelling allowance to cover these expeditions. That these were useful is undoubted, and it is hoped that they will be resumed when finances become more prosperous.

In the Punjab the one really notable event of 1933 in the engineering line has been the development in the Electricity Branch. On the last day of March, the main generating plant at Jogindarnagar was put into commercial service, taking over the load of the Amritsar Municipality which had formerly been supplied from Lahore. This required the energising of 178 miles of 132,000 volt line and the main line substations of Kangra, Pathankot, Dhariwal, Verka and Lahore, with its 10,000 Kw. synchronous condensers. As the reticulations in the other towns were completed and the local distribution sub-stations were built, tested and energised, electric supply has been given to them. Power generated from the waters of the Uhl river has been made available in fifteen cities and towns including Lahore in an area extending to Jullundur, Ferozepore, Lyallpur and Sheikhupura. The load is building up very rapidly and the prospect of obtaining full load for the plant within five years is very bright.

The issue of the Mitchell-Kirkness Report on the co-ordination and development of roads and railways has an important bearing on both

these branches ; one of the authors Mr. K. G. Mitchell has long been a member and a firm supporter of this Congress.

On the North Western Railway there has been good progress in reconditioning lines to suit modern loads and speeds especially in re-girdering bridges, the biggest work being the re-girdering of one track of the Jumna Bridge at Delhi in notably quick time, for which the girder-supplying firm who fabricated these twelve 214 feet spans in India deserve a full share of credit. This bridge carries the railway on the top boon and the roadway on the bottom boon. The replaced girders were wrought-iron of the late poor wrought-iron period. Other engineering work on the railway has similarly been a matter of consolidation, to maintain existing works, in some cases against fairly severe river attacks, or to counteract heavy flood damages, for in some areas floods established new records during 1933.

Irrigation even to a railway engineer like myself, is manifestly the most important engineering branch in the Punjab, a branch in which this Province leads the world, and in this branch the notable feature of 1933 has been the acceptance by Government of the five years Drainage Plan, which it is trusted will not only stop the rise of water table but lower it, not only stop the increase of waterlogging but cure this evil.

The problem of waterlogging became serious by 1917 and by 1926, one hundred and twenty thousand acres were already severely affected in the two Doabs between the Ravi and Chenab, and between the Chenab and Jhelum, while a much larger area of valuable land in them was already threatened.

Removal of standing water, provision of local seepage drains, and pumping have served their purpose to the full extent anticipated, but their effect has been local, and such measures cannot deal with the general rise of the water table in the Doabs.

The Irrigation Research Institute has found that the amount of canal water put on the land has had comparatively little effect on water table levels, but that there is a high correlation between this rise of water table and the monsoon rainfall, indicating that the rapid removal of storm-water by drainage is required.

Evidence on this subject is furnished by the regular tests of railway tube wells. The levels taken at these tests show seasonal changes in water levels in monsoon areas, and a general tendency towards an annual rise, which appear to be more marked in irrigated areas than in non-irrigated. An interesting example is Ambala Railway tube well ; here the 1933 rainfall was much in excess of normal, and the rise of water table has been so abnormal in contrast to former years that the centrifugal pump for pumping from ground level up to the high service tank is unable to deal with the amount pumped up to ground level by the air lift pump in the tube, an awkward situation where both pumps are worked by the one power unit, but strong evidence of the effect of monsoon rains on water table levels.

In Sind where monsoon is negligible the new canals are already water-logging land locally, for Sind soil encourages seepage and leakage, and they are causing considerable damage to the railway, a case that represents the reverse side of this question.

The Five years Drainage Plan then is a comprehensive scheme spread over five years to cure the evil of water-logging in the two Doabs, by excavating definite channels to outfalls into the rivers in each of the main areas between the several main canals and their branches, and it is anticipated that this plan, which will cost about 40 lakhs when completed, will not only stop the steady annual rise in the water table but will permanently lower it.

When the Honorary Secretary elected by you last year, Mr. R. B. Seth of the North Western Railway was transferred from Lahore in the autumn of 1933, Dr. McKenzie Taylor very sportingly stepped into the breach. The Secretary's job is rather a thankless one for he has to do nearly all the real work, and it is not always easy for the President and Council at short notice to find any one willing to do this extra work which can only be done by one within reach of the Congress records.

I desire to place on record my thanks both to Mr. Seth and to Dr. McKenzie Taylor for their hard work and for the assistance they have given me as President.

Before I conclude, on behalf of the Congress, I desire to record our congratulations to the following Engineers on the Honours they have received during the year :—

1. Mr. R. P. Hadow, C.I.E., on his Knighthood.
2. Mr. H. P. Thomas, on his C.I.E.
3. Rai Sahib Lala Ajudhia Nath Khosla and Lala Khushi Ram Sud, each the title of Rai Bahadur.
4. Khan Sahib Mian Iqbal Hussain, the title of Khan Bahadur.
5. Lala Labha Ram, the title of Rai Sahib.

I will now ask the Hon'ble Sardar Sir Jogindra Singh to be pleased to declare the Congress open.

SPEECH

BY

The Hon. Sardar Sir Jogindra Singh,

Minister for Agriculture,

PUNJAB.

I was surprised when Col. Macrae asked me on the telephone to open the Congress to-day in the unfortunate absence of His Excellency Sir Herbert Emerson, who had accepted the invitation. It is our earnest prayer that Lady Emerson's recovery may be rapid and successful and that they will both be in our midst again in the near future.

I consider it a great privilege to have this opportunity of welcoming you all here to-day, and to acknowledge on behalf of the Province, our sense of gratitude to Engineers, past and present, who have done so much to make our Province what it now is. The mighty rivers of the Punjab have yielded to your skill and their life-giving waters flow from field to field. A vast net-work of railway lines provides arteries of communication with the rest of India and with the outside world, while a system of well-constructed roads has opened out the countryside and linked the villages with the towns. As regards the latter, we can, I think, claim to be easily the most advanced Province in India. The Grand Trunk Road is now surfaced through the entire length of the Province, while out of a total of 2,700 miles of metalled roads no less than 73 per cent. are now surfaced and the remainder will be completed in a very short time. Our Sanitary Engineers have brought their knowledge to bear in securing pure water supplies and sanitation and our Electrical Engineers have given us the boon of electric light and power which, with the completion of the Mandi Scheme, is rapidly spreading through the major portion of the Province. Our Agricultural Engineer has been busy with the study and improvement of indigenous implements of cultivation. Our Superintending Architect has been responsible for the design of our more important buildings and has left a record of architectural beauty in our capital, of which we may well be proud. We are looking forward to a completion of the New Council Chamber, which has already been started, and will see the partial completion of the Charing Cross Scheme, which will be a lasting testimony to Mr. Sullivan's architectural skill. What is more, the Roorkee, Rasul and Maclagan Engineering Colleges are giving technical training and equipping the Province with a corps of its own Engineers. I cannot pass without acknowledging the debt which the Province owes to Captain Whittaker and Mr. Blaker in organising and conducting our Engineering education. They are both great educationalists

and men of high ideals. It has been a real pleasure to me to be connected with these two institutions. I am sorry that we shall soon lose Captain Whittaker and Mr. Miller-Brownlie, our Agricultural Engineer, whose places it is difficult to fill.

I must not weary you by repeating what has been said on previous occasions. Your achievements of the past have received unchallenged recognition. I can only express my own admiration and pay my tribute to the work that has been already undertaken and completed. Hills and rivers speak of your work, powers of nature moving under your direction bear testimony to your skill. Picture palaces and wireless installation in remote villages delight the eye and the ear under the magic of your command. It is your inventive genius which has resulted in—

"This worm of earth opening its wings to Heaven."

New discoveries are opening out new fields, and in a Province like ours the scope for future development is almost unlimited.

My message to you, to-day, is to remind you that it is only Engineers who can fight depression and bring back prosperity. They can dethrone the money changers from the steps of the Temple, re-establish sound money by refusing to accept change in the measure of values. They can study human requirements and lay down the most economic and equitable methods of production and distribution. The Punjab awaits an intensive campaign of development. It was Emerson who once said (I have forgotton the wonderful words he used) that a nation that could make England, in spite of its climate, such a paradise deserves the Empire of the world. We have now Englishmen and Punjabis working together in transforming the Punjab. We may well dream of clean villages and towns, with services well ordered and regulated ; fields and the farms smiling with crops, bordered by trees, planted regularly to afford both pleasure and profit. Every house and tank and village path should reveal the hand of the Engineer. You have a virgin field to explore. Along our roads and rail-roads, I should like to see borrow pits filled in, I should like rows of trees filling the vacant spaces, planted with deliberate determination to break the monotony of the road. The *kikar* and the *sheesham* must make room for more ornamental trees. I should like both the Road and Railway Engineers to take a pride in making their lines of communications as attractive as possible.

The Irrigation Engineers must not rest content with the laurels that they have already won. There are still desert lanes waiting for water, the resources of sub-soil and monsoon storage call for further research. New ways and new methods may make possible what was impossible before. Batteries of tube wells worked with electricity and series of storage tanks provide an interesting line of enquiry and investigation even if larger works like the Bhakra Dam are not within the immediate range of attainment. Then there is the perennial problem of the economic use of our available supply. Cannot we induce people to divide their fields into small compartments by offering a substantial inducement, such as rebate on any area brought to maturity over and above that which is at present irrigated ?

Irrigation and Railways are commercial undertakings but they are not commercial in the sense that modern commercialism has given to the word. Irrigation and Railways are essential services. Irrigation cannot ignore claims of the crops for adequate supply of water, nor can Railways encroach upon the profits of production. They have to provide their services at a minimum cost and water rates and freights can only be a part of the costs of production and transport. We need research in its widest possible terms to make water available at the minimum cost. We want freights to be so adjusted that commodities can flow from the field to the market without impediment. Irrigation and Railways both can prosper with the prosperity of the producer. The narrow view of having one's eye glued to the immediate profit is not a business proposition. Beggaring your customer is the surest road to bankruptcy. We need a greater appreciation of human values and human welfare. We need closer research into the relations between man and his needs. If the Irrigation Branch can reduce its costs per cusec and increase its duty by careful distribution it may substantially increase its profit. If the Railways could carry the same load and employ less power to do so, the savings would be enormous. Then again in the matter of competition between rail and road traffic, there are immense possibilities of co-operation. Last summer I ventured to suggest to Mr. Highet, the popular Agent of the North Western Railway, that it might be possible to secure co-operation of motor carriers by bringing them within the railway system. He very kindly investigated the proposal and said that it was not possible to do so. I know how difficult it is to make a new departure, but it may interest him to know that a scheme of this nature is operating successfully in South Australia. I may perhaps be pardoned for reading a brief extract from the report on the subject :—

> " A road carrier was operating a number of heavy trucks on a route about sixty miles in length, and had a good business, which had been taken from the Railways. The road was a busy one, and the heavy lorries were not only wearing the road, but contributed to congestion. There was a case for cancelling the license, but the Board after considerable effort persuaded both the carrier and the Railways Department that both they and the shippers would be best served by a co-operative effort. The arrangement ultimately arrived at provided that the carrier was to take his lorries off the main road and use them as feeders to the railway. He was given his own shed and siding at both ends, and a number of closed trucks, which he could look after loading. Since goods are classified for railway transport, he had to show on his way-bills the classes of goods carried, but the classification was simplified in his case, and he was given full truck rates. This paid the Railways since he invariably had full loads of mixed goods and did the loading and unloading himself. The result has been remarkable. The carrier has a better business than ever, and the Railways obtained a substantial addition to their traffic. The carriage of goods at the same time became cheaper to customers, as the carrier found he could provide door-to-door freight at the

same rates as the railways charged from station to station in lots smaller than truckloads. This co-operative effort not only cheapened the traffic, but also made it more convenient to shippers."

I have also heard that on branch lines it would be more profitable to run light rail cars. Take for instance the Simla-Kalka system. There is no reason why first and second class passengers or even third class should not be carried by small cars.

Our Hydro-Electric Branch is still in its infancy. It has an immense field of usefulness before it. The late Col. Battye and I had great dreams of the future of electric power in the Punjab. We hoped to have electric trunk lines running from Mandi to Peshawar and Lahore to Delhi. Mandi was to be only a nucleus; power was to be taken from every river and stream and switched on to the trunk line. A system of grids was to serve every village and town. Col. Battye, alas, is gone, and I have quitted the wheel, but I hope that our Engineers and our public men will see to it, that our first duty is to provide power for production and to provide it at a rate which would induce capital and brains to exploit the natural wealth of the Province. Power is available in abundance, and we have got only to harness it to use it.

In this new world, greed for profit has acquired a new meaning. We need a clear conception of what is profitable. The great teachers of mankind, and Ruskin, in our day, defined it. Human welfare must be more than the accumulation of wealth. Things of permanent value can only be realized in the sacrifice of immediate self-interest under whatever form it may be masquerading Our Engineers have constructed works of great magnitude, but they have got to show that there is nothing that we cannot make in India from the most powerful engine to the most delicate machine. They have not yet turned their eyes in this direction, but when they do, I have no doubt, our Railway Workshops will be in a position to meet all our requirements in the country itself. I am sure you can say that the word "impossible" is a word which has no place in the Engineer's dictionary. We need a co-ordinated attack all along the line, an associated effort to dispel the depression and to win back prosperity. Engineers have to play a part, not only in old familiar fields in which they have so far distinguished themselves but in the shaping of new policies, and in lifting the human problem from haphazard treatment to that of well considered planning. I hold that polcies must now be based on careful planning, carried out with wisdom and sustained with unfailing vigilance. Whatever may be the form of Government, it needs the support of Technology.

You all know the art of directing the power of nature to the service of man. You have shown that, though God made the world, He gave man the power to make everything subservient to his needs. He set no limit to your powers to draw on nature to your fullest possible capacity.

I pray that in the new era which is about to open your work will make the lives of your fellow men richer and happier, brighter and more beautiful and that you will share in the gifts which you distribute in the name of God.