中華郵政特准掛號認爲新聞紙類

土木工程

THE CIVIL ENGINEERING SOCIETY
UNIVERSITY OF CHEKIANG

本期要目

第一卷 第二期 中華民國二十一年三月
Vol. 1. No. 11 March 1932
浙江大學土木工程學會發行

土木工程徵稿啓

結巢治水,工程昉自先民.平道開渠,福利遺于後世.前修回首,不盡低徊;繼武無踪,深可惋惜.近世文明丕曜,着績工程.人事光華,奠基土木.道途修飭,不歌行路之難;橋索行空,永絕渡河之嘆.西歐渠範,北美規模.功在于人,法足式效.惟是繼絕學于古人,駸齊驅于當世;非借他山之石,攻錯爲難,不藉先進之思,突飛豈易.本誌基此精神,藉爲媒介.庶乎聚參攷之資,作印證之用.同人學殖淺薄,具宏願而怯汲深.諸君才識豐贍,抽餘緒咸屬至論.所望不吝金玉,惠錫篇章.名山碩著,固當寶若連城;片羽吉光,亦屬珍同拱璧.爲一步趨之致,約其指歸;幸加提挈之功,不我遐棄.

土木工程投稿簡章

(一) 本誌取公開研究態度,無論會員非會員,惠賜大作,一概歡迎.

(二) 本誌登載關于土木工程之文字.無論爲撰著,或翻譯;文體不拘白話文言,均所歡迎.來稿有用外國文者,暫以英文爲限.

(三) 投寄之稿,請依本誌行格謄寫並加標點符號.

(四) 惠寄翻譯稿件,請將原文題目,著者及其來源,詳細示明.

(五) 文中圖畫,除照相外,請用墨水繪製,務求清晰.

(六) 稿件揭載預否,不克預告.原稿亦不寄還.惟未登載之稿,因預先聲明,可以寄還.

(七) 稿件一經本誌登載後,版權卽屬本誌.如再由其他雜誌登載,請聲明由本雜誌轉載.

(八) 來稿揭載後,酌增本誌若干冊.

(九) 稿後請注姓名住址,以便通信.

(十) 稿件內容,本部有增刪之處,希予原諒.有不願者,請先聲明.

(十一) 投稿請寄杭州國立浙江大學土木工程學會編輯部.

土木工程第一卷第二期目錄

MODERN WATER WORKS FOR CHINA

H. A. Petterson

China has gone ahead rapidly with the construction of electric plants, but relative slow progress has been made in the development of modern water works. While hundreds of cities and towns have electric lighting, only a comparatively few cities have public water systems. Most of the electric plants have been started as private enterprises. In many cities, both an electric plant and a water works were originally contemplated, but the latter was eventually abandoned because of the large capital outlay. Electric lighting has seemed a much more tempting field in offering larger returns on capital invested.

It is doubtless true that the electric lighting and power business is more profitable than the business of supplying water to a city, but there is no question but that a modern water system can also be made to yield an adequate return on the capital invested if properly designed and managed. This paper will not go into management but will discuss two questions of policy and a number of design problems, in which, the writer's experience indicates, serious mistakes are made.

The questions of policy to be discussed are:—

1) The preparation of plans, or design of the works.

2) Number of contracts to be awarded.

THE PREPARATION OF PLANS

Not so many years ago, it seemed to be the vogue in China to award

a single contract to a foreign business concern, who made the design and supplied the materials. This method was followed by the promoters of many electric light plants and often with quite satisfactory results. However, I do not believe it can be applied successfully to water works. The design of water works is a special problem for each city. The choice of best source is often a problem that demands intensive study of local conditions and collection of data, which the engineer of the foreign importing house has not time to do.

I believe best results will always be obtained by employing a competent and experienced professional engineer. He and his staff make surveys, collect essential data and prepare contract drawings and specifications.

After the drawings and specifications are prepared, invitations for tenders or bids should be advertised in newspapers so as to reach as many bidders as possible. Bids should be publicly opened and read so there will be no chance for favoritism or suspicion of unfairness about awarding of contracts.

NUMBER OF CONTRACTS TO BE AWARDED

There has also been a tendency in China to award a single contract for all materials and labor. Some of the arguments in favor of the single contract are:—

1) Less work and trouble for engineers and promoters as there is only one contractor to hold responsible.
2) More likelihood of a big contractor being trustworthy and of getting good work done. .....

3) Possibility of getting better terms for payment; that is extending payments over a number of years.

The chief argument against a single contract is that of high co There is no question but that the total cost of the entire work will much less (20 to 30 per cent) if a number of contracts be awarded.

Suggested contracts for a water works are as follows:—

A) Imported Materials

1) Pipe, Fittings, Valves, Hydrants and Meters.

2) Pumping Plants.

3) Purification Equipment for applying chemicals and f filters.

B) Construction Contracts and Local Materials

1) Pipe Laying.

2) Construction of Pumping Stations. Erection of machine usually done by the firm who supplies the machinery.

3) Reinforced Concrete Structures, as sedimentation basi filters, clear water reservoirs, etc.

4) Office Building, Laboratory and other buildings a structures.

The above list shows only seven contracts, but sometimes a numb of subdivisions may profitably be made. As an example, take contract A It is possible that a considerable saving would result by buying the p and fittings from one firm, valves and hydrants from a second firm w specializes in these products, but who cannot quote as cheaply on pipe firm No. 1, and meters from a third firm. There are many other mi

contracts not listed above, such as

1) Pipe Tools

2) Machine Tools for a Repair Shop

3) Meter Testing Equipment

4) Laboratory Equipment

5) Sand and Gravel for Filters.

These contracts will of course not all be awarded at the same time. The pipe laying, for instance, cannot be started until the materials have arrived, so the contract for materials must be awarded a number of months before that for pipe laying. A schedule showing sequence of operations and time of completion should be prepared, and plans completed and contracts awarded somewhat in the order called for by this schedule.

Three important points in design which will be taken up are:—

1) Capacity of Works for Initial Installation

2) Master Plan for Future Development

3) Type of Filter.

CAPACITY OF WORKS FOR INITIAL INSTALLATION

A most expensive error may be made by designing a water system with too large an initial capacity. The usual procedure of the inexperienced engineer is to follow text book practice. This is to estimate the total daily consumption as the product of total population by an assumed per capita rate.

Using algebraic symbols, let

P = totat population

C = estimated or assumed consumption per person

Q = total daily consumption

$Q = PC$

There are two sources of error in this procedure, one in determining the magnitude of C, but the most serious error is in the value of P.

Let $U = kP$ = actual number of people who will use the public supply,

then $Q = UC = CkP$.

As a concrete example, take Hangchow,

P = 500,000 for the city and suburbs,

C = 10 is quite a conservative estimate,

then $Q = PC$ = 5,000,000 gallons daily

The works have been designed for a capacity of 1,375,000 gallons per day, but is not expected that the actual daily consumption will be as much as 200,000 gallons when first operate, nor over 500,000 gallons at the end of first year of operation. The inhabitants of Hangchow, as of most other old Chinese cities, have been obtaining water for centuries from various sources. Many of them will continue to use the old sources after the modern water works is built.

The safest guide to the probable consumption during the first year of operation is data from water works in other Chinese cities. The record of the Tientsin Water Works may be seen on the accompanying chart.

Too large an initial capacity means high construction cost and corresponding high interest charges. The interest charges alone may be greater than the gross income from the sale of water. Then bankruptcy is bound to follow.

A concrete example is given for the Hangchow Water Works:—

	Construction Cost	Annual Interest	Interest for 5 years
Approximate Cost as Actually Built	$ 1,250,000	$100,000	$ 500,000
Estimated Cost of Works for 5,000,000 gallons daily capacity	4,000,000	320,000	1,600,000

Suppose that the annual net income, after deducting operating costs, is $600,000 for the first five years of operation. Then the works will show a profit of $100,000 after paying of interest charges. If the more expensive system had been constructed, the interest will be greater than net income by $1,000,000. Obviously the works could not be operated very many years at an annual loss of $200,000.

MASTER PLAN FOR FUTURE DEVELOPMENT

As shown in the preceding article, it is wise to keep initial costs down, so that the plant may operate at a profit at the very start. It is also wise to plan the entire works, so that additions can be made to any part when needed. Master Plans should be made to control future developments. Then new work can be carried out according to a prearranged plan. Without a Master Plan, the final costs are apt to be much greater and results accomplished not nearly so good. An entire water works may be divided into three parts:—

1) Collection System, including Delivery Mains

2) Purification System

3) Distribution System, including Pumping Plants.

Master Plans are especially important for the Purification System and for the Pumping Plants of the Distribution System. If additional sources of supply may be needed, an outline should be prepared of surveys and studies to be made in connection with the compilation of essential data for proper development of the source or sources.

TYPE OF FILTER FOR CHINA

In view of the fact that returned students, and especially those who have studied in the United States, seem to advocate the use of *rapid filters* in preference to *slow filters*, a comparison of the merits of the two types of filters is advisable:—

The chief differences of the two types of filters are:—

1) Rate of Filtration.
2) Manner of washing the sand: Entire sand bed of rapid; top skimmed off of slow.
3) Use of coagulant practically compulsory with a rapid filter, optional with a slow filter.
4) Friction Head; 10 to 12 ft. with rapid, 3 to 4 ft. with slow.
5) Control of Rate; Automatic for rapid, hand operated for slow.
7) Nearly all of the slow filter, including valves and control apparatus, can be made locally, the only imported material being reinforcing steel. The biggest part of the cost of rapid filler is for imported materials and devices.

The two filters differ markedly in the quantity of water required for sand washing. The quantity required for the rapid filter varies from 1-1/2 to 4-1/2 per cent of the amount filtered. An average amount of

2-1/2 per cent may be used for estimates.

Only an upper layer from 1/2" to 1" thick is removed from the sand bed of the slow filter and washed. The amount required for washing should not exceed 50 gallons per cubic foot of sand washed.

In the following tabulation of cost of water for washing, the thickness of the layer is taken as 3/4". Also an average of 1,500 gallons per square foot is assumed to be filtered between cleanings. The cost for stripping, washing and replacing the sand is taken at $2.00 per cubic fong, or $0.02 per cubic foot. The lador cost of washing the radid filter is neglected, only the cost of water is included at $0.30 per 1,000 gallons.

Cost of Sand Washing per 1,000,000 Gallons of Water Filtered

	Slow Filter	Rapid Filter
Cubic Feet of Sand to be Washed	41.7	.....
Gallons of Water Required for Washing	2,085	25,000
Cost of Washing Water @ $0.30 per 1,000 gallons	$0.636	$7.50
Labor Costs of Stripping, Washing and Replacing	$0.834	.....
Total Cost for Water and Labor	$1.470	$7.50

Another basis of comparison is for annual interest and depreciation. This may be called 'fixed charges'. In view of present unfavorable exchange, the estimate given below for the rapid filter is believed to be very reasonable. That is rapid filter equipped with good control apparatu, will cost at least three times as much as a slow filter in China today.

Fixed Charges

	Slow Filter	Rapid Filter
First Cost per M. G. D. Capacity	$25,000	$75,000
Rate for Interest and Depreciation	8%	10%
Annual Cost for Interest Cost & Depreciation	$2,000	$7,500
Millions of Gallons Filtered in the year *Net*	330	350
Cost per Million Gallons Filtered	$6.07	$21.42

Fixed Charges and Cost of Sand Washing

	Slow Filter	Papid Filter
Sand Washing	1.47	7.50
Fixed Charges	6.07	21.42
Total per 1,000,000 Gallons Filtered	$7.540	$28.920
„ „ 1,000 Gallons Filtered	$0.754	2.892

Another item of expense not included is for coagulant which mnst be used with a rapid filter even in waters of low turbidity, while a slow sand filter can successfully handle water with a turbidity up to 100 p.p.m. without the aid of a coagulant.

A disadvantage of the slow filter is the larger area required for land. This is not a serious objection for most Chinese cities where land for the purification plant can be purchased quite cheaply.

Also a considerable area is required in any event for clear water

reservoirs to regulate between filters and high lift pumps. A saving in land area may be obtained by building the regulating reservoirs under the filters.

A distinct advantage of the slow filters for small plants is that they can be run by comparatively unskilled men, while the proper operation of a rapid filter demands considerable technical knowledge and supervision by a competent chemist and bacteriologist.

PROFITS FROM WATER WORKS

Three benefits from a public water system in which all inhabitants share are:—

1) Better health
2) Lesser fire bazard
3) Lower insurancerates.

The losses and suffering from an epidemic of cholera or typhoid fever are incalculable in terms of money. The loss from a single large fire, such as that experienced by Hangchow two years ago, is enough to build several water works.

In addition to the three benefits enumerated, which may be a called 'INDIRECT PROFITS', another benefit that should result from a public water supply is 'LOWER COST' per unit volume of water. That is a modern water system can actually supply a clear potable water at a cheaper price than is now being paid for an impure, dirty water delivered by water carriers.

A Water works should be built by the municipality. It should be operated for the benefit of the citizens, not as a money-making private

enterprise. Rates charged should be sufficient to pay interest on capital invested and to provide a sinking fund for amortization of bonds. If it can do this, the water works is really a very profitable enterprise in view of the benefits mentioned.

All of the larger cities of China are contemplating the construction of water works. This is very commendable. However, there is no reason why the construction of modern water systms should be limited to the larger cities. Every village or town with a population of 1,000 or more should have a public water supply. If such works are properly designed and operated, even the smallest can be made to pay a return on the capital invested. Works for a small town can be made very simple, so that no skill is required to operate.Also the number of people employed can be in proportion to the size of the works and of the town. The minimum operating staff is one man who could be trained in his duties by the engineer who built the plant.

Skilled supervision could be obtained by occasional visits of a water works specialist, who could be in responsible charge of some 30 or 40 small plants.

To aid the smaller towns in getting water works at low cost, the National Government could employ the skilled water works specialists, who would furnish designs and advice to the smaller towns without charge.

道路上特別危險處之防止法
(Protection of Special Danger Points)

原著 C. S. Mullen

譯者 吳光漢

在近來道路之勘定及設計,舉凡一切能致危險之情形,概應先知,並使之盡量免除.美國現有公路約 3,000,000 哩,其屬新近計劃者爲數頗微,但車輛之行駛,並不專限于新式道路,故在昔日所築之道路,應特別研究以資補救.凡在能使車輛發生危險之處,悉當加以令人注意之標記.

凡能發生危險之情形,是篇將詳爲論及,並舉明各種保護車輛之實用方法.

在弧綫上之特別危險

每一弧綫因須變更開車情形;及車輛行駛于弧綫處,有趨向內邊之自然傾向,皆有使車輛發生危險之可能性,如司機者依規定行車于弧綫之內邊,同時又有來車不循規則行駛,則在弧綫處危險可立卽發生.欲防止此種危險,其普通應用之方法爲在有弧綫路面之中綫,誌以白色綫紋,則車輛應行之途,自易顯定.

若弧綫過少,亦足以增加車輛發生危險之可能性.蓋在多山之地道路上弧綫常有繼續不斷者,司機者時時自警,反不致遭禍而平坦之地其弧之切綫往往甚長,俾車輛行駛時得增加速率.連于此種切綫間之弧綫,實係道路上最危險者,應妥爲標記.如弧度頗小,則弧綫標記應置于切綫上,並遠離弧綫之始點,俾司機者有充分時間減低速度,庶車行于弧綫時易于控制,同時其中綫之白綫紋亦應延長至相當程度.

上述情形,如在夜間,更爲危險.蓋司機者若非預事警戒,則行至弧綫時,恆爲來車燈光所擾亂,不及警備.因是爲夜間保護起見,遂應用發光標記.此

種反射式之發光標記,在遠距離已能顯見,即有來車之燈相援,亦無妨碍.

如連接兩切綫之弧度頗銳,除應用前述之標記外,須加一矩形標記.此種標記,漆以對角線紋,黃黑相間,其中央部份用一矢頭.此種標記所置之地位,須在弧綫外切線之延長線上,此種標記,亦應使之能夜間發光.

如弧綫過長,亦易發生危險.蓋司機者之普通慣例,在初入弧線時,減低速率,此後則逐漸增加.此種性質,在較短之弧線上,並不發生危險;但在長弧線上,則車輛常因速率之增加而增加離心力,遂使控制困難而發生危險,此種危險雖有標記,亦難避免.

凡新式道路,其弧線有超越高度 (Superelevation) 時,則行車速率,毋須減低,亦不致發生危險;但在舊式道路,鮮有此種超越高度者,故凡在新舊式道路相啣接處,應安置一種標記,俾司機者得變更其開車情形.

在頂點上之危險

凡路線上傾過高者,欲在其交接處得一適當之遠視 (Sight distance),實屬難能,故在此處常易發生莫大危險.

此種危險之釀成,多由於司機者在近山巔處避讓他車而發生.蓋不依規則之行車,不易立即恢復其應有之地位而避免與來車之衝突.此種危險,亦可用適當標記使之減少.如在路中誌以線紋,及在線紋兩旁另加闊度,設若山地路面不及18呎者,則沿山巔約 200 長之路面,須放闊至18呎或20呎

過斜坡度上之危險

在高山區域建設道路,往往爲減少開挖而用極高坡度至 8%, 有時或且過之.當行車下傾時,除非富有司機經驗者,恆易發生危險.普通司機者行車于略高坡度時,恆用煞車 (Brake), 以減少速率成爲習慣.如一旦行車于長距離之高坡度時,往往亦應用此種慣法,而致焚毀煞車或車身全部.欲防止此種危險,其最適用之方法,則爲特豎一標記於高坡度之頂點,寫明「下山用第二齒輪」.

氣候上之危險

雨:在大雨時期,因路面上之灰塵油點已由雨水冲淨,遂不致因溜滑而生危險;但在小雨或濃霧時,路面上之灰塵油點不易冲刷,而成爲極滑溜之物質,行車不愼,危險殊多.對於此種危險如用標記,則用不勝用,除非有一部份之路面,天雨時特別溜滑,則在此處特置標記,警告司機者如「雨天危險」及「須用煞車」.

冰及雹:冰雹不克預告,司機者當各自留意,但如有一段路面冰已溶解.一段路面冰尙凝固時,則行車最易發生危險.爲安全計,路局應設立暫時標記,與其他標記相異,係豎於路中者,日間懸紅旗夜間懸紅燈,以示重要.

除設立標記外,冰凍之路面上,並須洒以泥沙或煤屑,以減少溜滑之危險.

霧:行車遇霧,最爲危險,但除留心駕駛及用車頭電燈外,別無他法可以預防危險.

鬆虛路肩之危險

泥土路肩係支持及保護路面之用,並非增加路闊,如車輛行駛肩上,設或路肩鬆虛,則往往發生極大危險.路肩鬆虛之原因,大半經冰凍修理或種草等.其防止之方法,可豎立暫時標記於路肩鬆虛處,待結實後方始移去.

瓶頸式路上之危險

闊狹兩路或路橋相接之處,乃成瓶頸式路(Bottle neck).此處車輛擁擠,危險亦多.欲避免此種危險,須持管理方法之妥善,而以標記輔之.

交叉點之危險

避免交叉路危險之原則有二:一,在設計時須有相當之闊度及視遠(Sight distance).二,良好之車務管理.

當在兩主要路相交而視遠甚短時,最易發生危險,故建築時所有障礙物,務須除去,如有不能者,則須用第二原則以資補救.

適當之標記上繪交叉符號,離交叉數百尺前,設置路旁,並注明速率限制,以警告司機,預爲變更其行駛方法,以免至交叉處發生危險.至支路與幹路相交,則在支路上之行車,在穿過幹路之前,須有完全停止之可能,即使不用停止記號,于此等地點,行車之速率亦應減至每小時五哩.

如上述標記,尙不克保持安全時,則用自動行車號誌.此種號誌,常作綠光,賴電流之連接,凡他路有車駛近時,即變作紅光,車過仍作綠光.

路面凹陷之危險

路面之凹陷 (Dip) 其最初目的,在利於瀉水;但行車危險,亦易發生,最新道路中,此種式樣,已不存在;惟美國舊省道尙有此型.其防止方法,厥惟標記,其標記應立于離凹陷兩端各三百尺地方爲妥.

結論

1. 道路上之危險,多在未及料之轉變處,此種危險,可用適宜之標誌以減少之.

2. 應留意于不需要,及易于誤會之標誌.

3. 在重要之路線,所有標誌,宜日夜均能明顯.

4. 市中之車務管理者,應與公路局合作,以執行行車規則,及解釋此種安全標誌之功用及其利益.

飛機測量於我國之需要

周 倘

邇來我國努力建設,於交通水利等重要工作,均設專局負責進行;祇以缺乏準確圖表,其初步工作均側重於測務。過去成績,固已斐然可觀,測量人才,亦不能謂少;惟其測量方法,由各地各別進行,且限於陸地測量,既甚遲鈍,復不經濟。以如斯廣大之中國,欲謀建設,測量一方,誠應切實研究,統盤籌劃,以最經濟方法,迅速製成準確圖表,方足以供新建設之需求,所謂最經濟之測量方法無他,即飛機測量是也。考歐美各國,對於攝影測量一道,異常進步,因其合於上述原則,近來一切建設事業,幾已一致採用。吾國全部面積約有一千萬平方公里,與德國比,彼之面積不過三十萬平方公里,曾費六十餘年之大地測量,年耗經費二百萬馬克而始告成。方諸我國,如亦沿用舊法測量,計非一二百年不辦,所需經費實難預計。如吾國之財力,斷難辦到,且須經過如許之長時間,亦覺斷難久待。改良之法似非採用飛機測量不爲功。特飛機測量開辦費亦頗大,若各機關獨自進行,則一機關之能力有限,飛機之效能不能完全利用,仍復不甚經濟。據尙個人意見,及經驗所得,應由中央舉辦,併須與各省測量機關有直接之連絡,互相利用,方克收經濟而又迅速之效果。舉其測量重要目的,約有下列三種:

一,關於國防及軍用地圖;

二,關於建設工程之應用圖;

三,關於田產地籍圖。

上述三項測量,如用以飛機攝影方法,不特出圖迅速,且可節省經費,而其準確精詳亦合事實上之需要,人才亦不須如人工測量之多,測量方法及比例尺度各視其目的而定。

一,關於國防及軍用地理圖之測製

此種地圖,係供普通查察地勢如何,幅圓若干之用。爲經濟計,可用一萬五千分一至二萬五千分一之比尺,測得後乃可湊集各片轉製爲五萬分一及二十萬分一等比尺之地圖。未施測前,預備工作則不能免,如設立標點及一二等三角測量,幷測水準,定各點之高度,以便轉製等高綫。

二,建設工程應用圖之測製。

對於此項用途,測製二萬分一,或二萬五千分一之一覽圖,已足應普通之需求。在該圖上選定建築地段,再將需要部份轉製五千分一或較大比尺之圖,稍用地面測量以補充之。一覽圖測成後,爲普通大概計劃,暫可不必施以精密校準,以節經費。雖其尺度不如經精密校準之圖之確,但地面形勢景象以盡數攝出,儘足應用。此種辦法,尤適宜於未施三角測量而須于事後補測之處。惟飛測前,須先設定標點,置以相當標識,以資日後施測三角時有所根據,而便于影圖上檢覓。若繪製河流水道地圖,用以籌擬整理計劃,凡未施校準之影圖,亦足需用。他如繪製城市地圖,則此項五千分一至一萬分一比例之一覽地圖,又爲有價值之輔助物,吾人可藉之以定界限。

三,田產地籍圖之測製。

中國幅員廣大,建設上各種輔助物,需要甚切,而田產地籍圖尤爲重要。蓋目下各業主之田畝山場,究有若干,雖政府亦不得而知,故確實整理田賦,使人民納應納之稅,爲事實所難能。此項地圖宜於最短期內促其實現,以增國庫之收入。專爲整理田產之圖,應先製五千分一或四千分一之一覽圖。人烟稠密之處,則製二千五百分一或二千分一之圖。是項測量,若於適當良好之時期內施行,其田地區分及農植物種類均能明晰顯別,而各業主應納之稅額亦可各按土地之價值而定適當之標準。故用飛機測製田產地籍圖,於國家目下之經濟關係甚大。測圖之重要目的,在求所有地產之正確總數額,予政府當局以整理之標準及方法;至精密求得各個業戶所屬之面積,尚在其次。用飛機測得之地圖,與用普通測量方法所測之結果相較,其精確至少

相等,但飛機測量所需時間,祇及人工測量之一小部分。此項地圖亦須有三四等三角點爲之根據,而其三角點則祇須以導線測量補充之。

按上述各項目的,均以陸地測量(三角及水準測量)爲飛機測量不可少之預備工作者,因用飛機所測之圖,初係一影片,不能確知其比例尺度,必須先於地上設立標點,計其縱橫座位及高度,並將各點連接繪於紙上,(卽所謂三角網是也),乃能利用此已測標點之縱橫座位及高度,而以校準儀精確校準,飛機所測之影圖,蓋依幾何學原理,三點成一平面。飛機施測時每一照片上至少攝有三角點三點。製圖者,將照片置於校準儀,漸漸旋動,使照片上之三角點與三角網上之三角點符合,卽能繪製精確之地圖。其施行預備工作之方法,隨測量目的及地面情形而異。爲顧全經濟及各地互相利用起見,須將進行方法作整個統一計劃,幷及時預備飛測地段,俾于天氣及水位並時季合宜或必要時,卽可飛測,不致因他種工作而礙及飛機之進行。是以須由中央機關爲之策畫處理,會核各處需要情形,編造各項工作程序;如事實上有變更預定工作方法或程序之必要時,中央亦有隨時變更之權,不須經許多轉呈機關,空費時日,以誤不多得之飛測時季。其組織及規程,應仿照歐洲之私營空中攝影公司之性質,力求其經濟便利。現有國內各測量機關,對於辦理飛機測量預備工作,均應互相合作利用,如測製河流水道地圖,則須有各流域水利委員會及各省水利局之協助,先作三角水準等預備及補充工作,以便測就後卽行製圖,及計劃整理。查浙江省水利局業已採用飛機攝影方法,實行測製河流水道地圖。該局備有聯片攝影鏡及飛機一架,校準尺度印製圖件器二副,本年內約可製就五千平方公尺之校準地圖。若天氣良好,經費充裕,則測量工作效力,尙可增加,或尙有爲省外施測之可能。飛機攝影甚速,大部分之時間,則在精密校準及製圖,故欲迅速,須多備校準製圖儀。現浙江省水利局在本局範圍內工作甚多,外省擬托代辦者亦屬不少,因限于經費無法添購高價之校準儀,因之而外省托辦之工作,不能盡量

接受。如中央有一統一之機關，則經費較裕，儀器自可多備，且指導統一，效能大可增加；而南京總部已備之校準儀及飛機，亦皆可利用：此所以飛機測量有歸中央統一辦理之必要也。如欲繪印等高線地圖，祇須另備自動繪畫之等線儀一具，即可由已攝之影片中，製出等高線，無須另測，甚爲便利。不過此項儀器價甚高，約須馬克六七萬枚，普通機關非易辦到。若測務統一，總部自能置辦；加之各測量機關一致合作，不難于短時期內，製出可以應用於中國目前需要興革事業之圖，其正確之田產地籍圖，尤爲國家之唯一財源。故此種新方法，甚值得吾國辦理測務當局之研究。

麥卡達路冬季鋪瀝青法

Winter Paving With Asphaltic Concrete on Macadam Base

Walter H. Flood
陳 允 明

鋪瀝青地面,每不適于天氣太冷之冬季,以其易于凝固也.惟在一九二九年,美國支加哥地方,曾于甚寒之冬季鋪成二吋厚之瀝青地面 67,000 方碼.其成功之原因 1.爲過熱之瀝青混合物,鋪時工作敏捷.2.即刻加以甚厚重之壓力.詳細之工作情形,頗堪注意,茲述之如次:—

混合物與混合程序

此次所用者,爲墨西哥瀝青.其滲透度(Penetration)爲54.混合物中石灰佔48%,沙佔30%,塡入物(Filler)佔15%,瀝青佔7%.混合物之粗細及瀝青之成份,平日常作二三次之試驗,所得平均結果如下:—

瀝青	6.9%
經過 200 號篩箕	12.7 „
„ 80 „	10.2 „
„ 40 „	13.2 „
„ 10 „	6.7 „
„ 4 „	20.8 „
„ 2 „	29.5 „

上述之瀝青混凝土,含石灰約有50%,在美國常用于鋪設汽車公路成效頗著.

施工時常備二處混和工場(Mixing plant),其一約離工作地十三四哩,另一工場約離五六哩.混和程序一如平常,惟加以寒天應有之注意而已.混合物因天寒凝結甚固,不易從車上傾出,故車箱必須加熱始能溶散.其加熱方法,係用蒸汽管圍繞車身,另以數小管通達車底,車上覆油布以護熱,如此

數車之貨可同時溶散,以利卸下,施用時愈速愈妙,以免再行凍結。

混合物混和後以鋪軌道之車輛輸至施工地點,每車可裝十一噸,因在寒時混合物離工場時溫度約需 375°F 搬運時熱度散失約 15° 度故達施工地點當在 360 度左右。

鋪面工作于八天內完成,每日溫度由氣候局測定如下:

日期	最高度數	最低度數
Nov. 28	20	15
„ 29	8	1
„ 30	17	1
Dec. 1	29	20
„ 2	16	8
„ 3	17	1
„ 4	28	12
„ 5	45	28

如上述之低溫已足爲工作之累,但有極凜冽之風,使混合物易于凝結,抑且令人畏縮不前,當夜間壓路機亦須停置汽車間內,庶不致將機件凝結。

鋪置與滾壓之程序

在未加瀝青混合物以前,路基上之散石等宜先掃除,然後用工人二組,每組十四人,六人持耙,八人持鏟,以鋪瀝青混合物。如路邊無階石,則以Berm爲攔瀝青混合物,以鋪至 Berm 爲止,通常以四十四噸瀝青混合物,同時傾于路上可鋪 400 方碼。

重八噸至十噸之壓路機六輛,同時運用,且以天氣寒冷如此,毫無障蔽之路面易于凍結,故此六壓路機須隨時開動各無阻滯,以便路面在熱時卽得充份壓力。所鋪路面在壓路機緊壓後,僅有髮細之裂痕,與蜂房式之小隙,困難之處在使路面平勻,蓋因天寒瀝青易于凝凍不易耙平也。最須注意者

乃在維持混合物一定高溫與急速輸送。

在此嚴寒之氣候,面層之工作不能用人工方法,蓋低溫度不能使瀝青擠成薄層,同時更須施工迅速,因此須用壓力分佈機以其工作極快不待瀝青混合物之凝固,即以重壓加之。

面層所用之瀝青性質與舖面者同,惟滲透度爲 120 而已。在面層完成以後,以$\frac{1}{4}$—$\frac{3}{8}$吋之石屑散播其上,再壓以壓路機。石屑須先加熱以利與路面黏合,大約一方碼需15磅。

結 論

此路工作進行之速度,開寒天舖瀝青路之新紀錄,不過在如是寒冷時溫度降至 1°F, 其路面所受之壓力,是否足夠,常屬問題。即在其餘數天,其溫度亦遠在平常造瀝青路面之下。依每日所取之路面小樣,得知其密度爲 2.371 至2.408 約爲由計算所得之密度之97％至98.5％

實際上瀝青路面殊不宜于在酷寒之天氣舖設,其不良之結果顯示于人者雖多,而此次計劃之成功,則足以證明有舖設之可能性矣。在隆冬時無論何種所謂永久路面咸不能舖設成功,而瀝青路面惟有雨雪能阻滯其進行耳。

欲使嚴寒時瀝青路面能舖成者,首須注意爲工作進行之迅速,以免混合物之凍合與多數接縫之需要,故不但使混和工場之容量加大,而運輸之時間亦務求短促。

GENERAL PRINCIPLE OF WATER POWER DEVELOPMENT

by 丁人鯤

Within the last four decades, one of the most wonderful and romantis engineering achievemant that had amazed the whole world is the water power development. Although the Utilization of water energy for power purposes is quite an ancient practice, but the great objection of limited use locally had preocuted from its power extensively utilized, until the introduction of electricity for long distance transmission.

Water power is better than any kind of power derived from fuel, oil and petroleum for many reasons; but the most important two are:(1)inexhaustible and self-renewing character, and (2) its ability to furnish much cheaper power. Other advantages are better hygienic conditions; better speed control; reduction in maintenance cost, depreciation and accidents; increase in production, and efficient management of machines, tools etc.

By water power or so called hydro-electric power engineering is meant the kind of science that can transfer water energy into electric power, one wants to develop water power, two kinds of knowledge are essential, these are the hydraulic engineering on the one part; and the electrical engineering on the other part.

By admitting the water flowing from a high level to a low level into a water turbine, turbine tends to rotate due to the potential and kinetic energy of falling water, whish strikes the buckets or vanes of the turbine.

The methed of obtaining this falling water is either from a natural water fall or to build a dam for a certain head, and then to construct open channel or closed penstock for the convegence of this falling water from the site of fall or dam to the power house. By connecting the electric generator to the shaft of the turbine either direct or indirect, either vertical or horizontal, electrical power is then produced from the hydraulic energy. This electrical power can be utilized either in local region or to distant cities by transmission lines and intermediate distributing stations.

Water power is chiefly dependent on two factors: namely, the Head and the Discharge: The head is the total height of the fall (or it is the difference of elevation between the head race and the tail race) the discharge is the total flow of water passed in a specified time. Both can be obtained by measurement. Then the theoretical horse power of the river can be calculated by the formula.

$$\text{Theoretical H. P.} = \frac{\text{Discharge} \times \text{Head}}{8.8} = \frac{QH}{8.8}$$

From this formula we can see that either a fall of one foot with a discharge of 8.8 cu. ft per second or one cu. ft per second dischargs with 8.8 feet fall will produce one theoretical horse-power.

In obtaining actual horse power, we must consider different losses of power occured from friction and shock in guides and passages of the wheel; the friction and leakage of shaft; the eddy in the draft tube; the friction in the penstock, etc. These losses ranges from 10% to 30% consequently, the range of efficiency is from 70% to 90%; 80% is generally taken for estimation. Therefore the formula for estimating actual horse power will be

$$\text{Actual H. P.} = \frac{Q \times H}{8.8} \times 80\% = \frac{QH}{11}.$$

While the actual electrical energy developed (expressed in kilo-watt,) should consider the combined efficiency of generator, transformer, etc, 90% being generally assumed as the average value. Therefore the formula for estimating actual electrical power delivered from the power house will be

$$\text{actual K. W. utilized} = \frac{Q \times H}{11} \times \frac{.90}{1.34} = \frac{QH}{16.4}$$

For the purpose of illustration, the world famous Niagara falls will be taken. The vast amount of water flows through this fall to Lake Ontario at an average discharge of 210,000 cu. ft. per second; while the drop of this fall is about 300 ft. So, by the application of the formulae just mentioned, we have

$$\text{Theoretical H. P.} = \frac{210{,}000 \times 300}{8.8} = 7{,}160{,}000.$$

$$\text{Actual H. P.} = \frac{210{,}000 \times 300}{11} = 5{,}730{,}000. \text{ (based on 80\% Eff.)}$$

$$\text{Actual K. W. utilized} = \frac{210{,}000 \times 300}{16.4} = 3{,}840{,}000. \text{ (based on 90\% Eff.)}$$

In the design and construction of any water power plant, three things are of vital importance on the hydraulic side, namely, the dam; the head race and penstock; and the turbine. Other three things are essential on the electrical side, these are the generator, the transformer and the distributing line. The construction of building for the power house is also important. Other minor things, such as auxiliary steam engine, pumping machinery, and various other details are also needed. Due to limited space, only these three important things on the hydraulic side will be disscused briefly as follows. Dam: The principle of a dam for water power is practically the same as those for water-supply, irrigation and river improvement purposes.

The main object is to concentrate the fall of the river at one point, so as to convey the water economically to the turtine, and to store the water so as to act as impounding reservoirs. The dam should be built to required height, of proper material, of water-proof surface, of enough strength to resist sliding, and overturning during great flood on storm. Flood gates should be used to control the extreme floor heights near the dam site; spillways should be built in the dam as a passage to permit the escape of flooded water. There is a close relation betwecn the location of power house and that of dam; because good location of both will afford great economy in developing maximum head and give more safety protection of powerhouse. The head-race and the penstock: The purpose of the head-race is to convey water at the dam site to the wheel-pit or penstock; and the purpose of penstock is to direct the water from the pipe line to the turbine or wheel. Both have the function as an intake for the water power plant. Head race may be built either of open-channel or of pipe line. Penstocks are of two kinds, namely, the closed and the opened. Closed penstocks should be used for heads higher than 20 feet, while for head below this value, open penstocks are generally preferred. Penstocks may be built of stone metal, concrete in modern power plants; while wooden penstocks are commonly used for small plants. Each individual penstock used to supply each one turbine is the general practice; but sometimes, a number of turbine can be set in the same penstock for the sake of economy. Both pipe line and penstock should be designed for least frictional resistance to the flow of water, otherwise, the loss of power will be considerable great.

The turebine: There are two kinds of turbine in general use, namely, (1) The Tangential turbine or impulse water wheel and (2) The Reaction turebine; the former is suitable for high head and high speed, and its action is based upon the impulse when the water jet strikes buckets or vanes fixed around the wheel; while the latter is good for great dircharge and medium head and its action is based upon the reaction, where water passes through closed passages formed by curved vanes and completely fills these passages. The essential parts of a reaction turbine are the runner, the gate or passage mechanism and the draft tube, while that of the impulse wheel are the wheel disk, bucket or vanes and nozzle. These things are not intended to be described here. The design and selection of turbines is very intricately related to the design and lay-out of the power plant, because turbines are the prime movers of the plant, or the controlling factor of whole project, which is just as important as the steam engines in steam power plant. Therefore, in order to get good result, the general layout should be the joint conception of plant designer and the turbine designer.

Electrical machineries: Now, having briefly stated the important things on the hydraulic side, it is not necessary to state the essential things on the electrical side, such as generators, transformers, switch-boards, distributing towers and transmission lines, because those are more or less the works of electrical engineers. Although when the horse power capacity of the turbine is known, one can figure out the corresponding capacity of generators, transformers, ets, then, select and order those equipments for installation. But the advice and service of electrical engineers are always

needed before and during the installation of electrical machineries; otherwise, a complete success of the whole plant cannot be secured.

材料試驗結果

陳仲和

材料試驗之結果,乃在多種境況下所產生之結果也。而造成此境況之要素,殆難以一一數,例如木材之產地儲藏法年齡等,鋼鐵之成分製造法含炭量等等,皆與其强度有密切之關係。實驗者未能遍訪詳察之,無已則取市上所常用者擇要試驗之。茲章所記,卽根據一年來各級同學試驗之結果,彙集成篇。然人非一人,時非同時,其間手術氣候濕度等之差別,所影響於强度者仍巨,閱者祗作含有微差之近似值觀可也。

I 木材　本室所試驗之木材,爲木禾麻栗本松洋松杉木五種,皆取給于學校附近萬安橋脚協興木行。其產地除洋松外,浙江境內多有產之者。杉木則以徽產爲多,下列價值卽據該行所報告,至杉木則以根數大小論,不可以體積計,大約介于本松與洋松之間耳。各種木料,又以質地之不同,價值仍有高低,下表乃爲平均值。

杭州市四種木材之時價

	麻　栗	本　松	洋　松	木　禾
魯班尺每立方尺	$ 1.25	$ 0.80		$ 1.20
英呎每立方呎	$ 1.625	$ 1.04	$ 1.44	$ 1.56

壓力試驗　本室所用之試驗機爲安斯婁混合試驗機,該機能力 50000 磅,爲瑞士產,可用以定各種材料之張力壓力曲率力剪力等,其力之大小,可由自旋轉針自動指示,不必如美製烈赫萊試驗機之定須手搖也。

木材壓力試驗之樣子,爲(1)2吋見方2吋高之立方體,(2)2吋見方8吋高之短柱,(3)2吋見方16吋高之短柱,三種,茲爲表示各樣材料之個性差異起見,將各組結果之平均值悉數列表于後。

木材沿木紋方向每平方吋之最大抗壓能力

	木禾			麻栗			本松			洋松			杉木		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	5790	5480	—	6610	5960	6920	4618	5880	5486	5950	5370	5060	—	4087	4087
	6170	5330	5590	6710	5510	6790	4670	4930	5300	5610	5770	5810	4420	4190	4850
	4750	5475	5300	5475	5600	5225	5450	5100	4750	5350	3725	4686	3850	3875	3850
	5450	6125	6400	4176	4625	4275	5475	5350	4500	3950	3425	5125	3525	3415	3525
	4950	5750	4950	6250	4500	4275	5250	4275	5375	3625	3600	3925	3850	3500	3375
	5500	5600	5600	6700	4375	5844	5158	5656	3750	6075	4375	4393	3925	3150	3338
	5243	5142	5578	7920	6773	—	5165	5362	—	5412	5400	—	3925	4655	4150
	5237	5142	5550	7860	6550	—	5133	5317	—	5574	5420	—	—	4683	—
平均值	5386	5505	5568	6438	5450	5555	5239	5234	5032	5181	4773	4999	3915	3988	3882

觀以上各項之平均值,可知柱長與最短邊之比,若小于十倍時(在本試驗$\frac{l}{r}=8$)影響於各種木材之强度,尙無顯著之差異,故爲便利實用計,可令五種材料之每平方吋之最大抗壓能力如下。

木禾	麻栗	本松	洋松	杉木
5500	5800	5170	5000	3900

引伸力試驗　所用樣子爲斷面 2"×$\frac{1}{2}$" 之扁平板，兩端較厚約半时許，試驗機同前，表內所列數值，爲每組之平均值，即每兩根之平均值，故總平均值乃每樣二十根所得之平均值也。

五種木料每平方时之最大引伸力表

	木禾	麻栗	本松	洋松	杉木
	10970	12450	9530	7230	5250
	17100	11480	10625	11600	
	12675	16050	11600	13100	
	14100	22000	11000	12420	
	15380	12785	7900	7495	
	14365	14900	9200	14200	
	9000	17900	9200	10750	
	10794	9675	6750	10500	
	13800	15400	11800	7312	
	16586	10336	11510	15020	
平均值	14300	13500	9910	10960	5250

彎曲力試驗

五種木材之最大單位彎曲力 磅/平方吋

	木 禾	麻 栗	本 松	洋 松	杉 木
	9500	8900	5800	5250	4600
	10600	10000	5250	4840	4350
	10290	9170	6950	5420	6640
	10500	9450	8300	6090	4250
	10600	10680	8760	5480	4380
	8900	8340	5850	5030	4780
	9350	6200	7020	5900	5300
	9320	8770	7260	4620	3710
	10794	9675	6750	7312	5260
	10238	10125	6188	6800	
	9112	7540	6750	7300	
	10555	9675	6566	7472	
平均值	9050	9940	6620	5920	4810

剪力試驗　剪力試驗分爲兩種,(1)沿木紋方向(2)垂直木紋方向,茲將兩種每六樣之平均值列表于後。

四種木材之最大單位剪力 磅/平方吋

	麻 栗	本 松	洋 松	杉 木
沿木紋方向	1000	344	260	137
垂直木紋方向	2055	1241	1222	566

綜觀上述價值表,及各種應力表,可知洋松與本松價值之比爲10:6.9,而各種應力,除引伸力外,洋松皆不及本松,然國中較大建築,鐵路枕木橋梁等,皆採用洋松,鮮有用本松者,推原其故,當不外下列數種,(1) 對于本松强度之懷疑,計劃者無所根據,不如用洋松便,(2) 本松無一定之尺寸,購採非易,(3) 對於本松耐久性之懷疑,如腐朽開裂等,綜是三因,本松遂不能與洋松競。現近金價日貴,洋松價值,飛漲無已,倡言抵制而漏巵不塞,殊可惜也。惟不可變者本質,今本松强度,既不亞于洋松,是本質可恃也。無尺寸則吾尺寸之,塗注防腐劑,改良乾燥法,一轉移間,本松卽洋松矣,何必以國中建築供他人市場乎,甚願國人注意及之也。

II 金屬　試驗用之金屬爲鋼,熟鐵,生鉄,銅四種,生鐵塊爲校工所翻製,非臻上乘,餘均購自杭市五金店,爲一吋或半吋徑之圓桿,茲將各種市價表示于下。

	每磅價值	出品處	牌名
熟鐵	$ 0.16		
黃銅	$ 0.50		
鋼	$ 0.30		黃一牌

引伸力試驗　每桿直徑約半吋,其應力變形圖,由試驗機附件自動畫出,下列所列之弛點 (Yield point), 卽根據應力變形圖中所指示,惟鋼與熟鉄之弛點極爲顯明,故差別常微,銅與生鉄無顯明之弛點,故各人之觀察點不同,差別頗大,茲將各組結果列後。

四種金屬之引伸力 磅/平方吋

	鋼		熟鉄		銅		生鐵	
	弛點	極力	弛點	極力	弛點	極力	弛點	極力
	63400	104000	55400	66000	46650	73200	——	17100
	64200	99000	49000	51800	49300	65000		
	62000	101100	48300	62000	42040	65500		
	55900	73900	46900	52000	47400	67800		
	61500	115800	50700	60500	52500	63250		
	65200	106900	47300	60700	48400	64300		
	62000	104200	51000	62000	38700	67700		
	64500	110000	50800	65100	38200	66600		
	63492	100530	44651	65116	34741	57746		
平均值	62465	101803	49340	60357	44200	65788		

三種金屬之極力 磅/平方吋

	鋼	熟鐵	銅
壓力	115850	81050	83050
剪力	77300	50250	36250
彎曲力	180000	82300	95000

上述數值係六根樣子所得之平均值。

III 泥磚 此間所用泥磚,都購自杭市源茂磚瓦廠,多係嘉興出產,市上通稱大紅磚,小紅磚,大青磚,小青磚,茲將四種磚塊尺寸價值列表于後。

磚　名	尺　寸	每萬塊之價值
大青磚	$1\frac{15}{16}'' \times 4\frac{1}{2}'' \times 10''$	約 100元
小青磚	$1\frac{3}{8}'' \times 4'' \times 8''$	約 60餘元
大紅磚	$1\frac{15}{16}'' \times 5'' \times 10''$	約 100元
小紅磚	$1\frac{1}{2}'' \times 4\frac{1}{4}'' \times 8\frac{5}{8}''$	約 60餘元

泥磚應力之差異甚大,良由于製造之不均勻,茲將十五塊之平均結果暨其中之最大值最小值分列于後。

四種泥磚之抗壓力表

磚　名	最大值	最小值	平均值
大青磚	995 磅/□"	500 磅/□"	801 磅/□"
小青磚	396 "	533 "	912 "
大紅磚	1395 "	476 "	1049 "
小紅磚	1316 "	486 "	817 "

四種泥磚之彎曲力表 磅/平方吋

磚　名	最大值	最小值	平均值
大青磚	394	191	284
小青磚	410	191	366
大紅磚	730	302	441
小紅磚	533	187	281

上列彎曲試驗時樣子,係平放,卽加力於厚之方向也。

VI 混凝土 本室所用之水泥,爲馬牌,唐山啓新公司出品及泰山牌,龍潭中國水泥廠出品,兩種,但因個人手術之不同,影響于强度甚鉅,故祇舉其近似值不復類別焉,所用碎石(沙石)爲徑 $1\frac{1}{4}$ 吋以下之沙石,沙之均勻係數爲 3。分子容積比例爲 1:2:4,

加水量試驗 定加水量之法有三(1)沉陷試驗 Slump Test (2)羅馬圓墩試驗,(3)流桌試驗 Flow Table Test 本室所採用爲第一種,法將各分子調和均勻,加入所估計之水量,乃將調和之混凝土漿放入高十二吋直徑六吋之電鍍鐵筒,分二次裝入,每次用徑約 $\frac{5}{8}$ 吋鋼桿,搗四十次,乃將鐵筒正直提起,離開混凝土,然後量混凝土之沉陷幾何,如沉陷爲半吋至 1 吋,是爲正當加水量,由上法試驗之結果,1:2:4 混凝土所需正當加水量,水與水泥之容積比例爲 1:1。

壓力及彎曲力試驗 壓力試驗所用樣子爲高 10 吋徑 5 吋之圓柱,彎曲力試驗所用樣子爲 4"×6"×40" 之短樑。水泥比爲 1:1 所列數目,爲 24 塊樣子平均值。

1:2:4 混凝土壓力及彎曲試驗表

每平方吋之抗壓力		每平方吋之彎曲力
七日	二十八日	二十八日
661	1432	347

鋼桿與混凝土黏結力試驗(拉出試驗 Pull-out Test)

水泥比	混凝土成分比	日期	每平方吋之黏結力(磅)
1:1	1:2:4	28	456

V 水泥與膠泥 因各人手術及天氣變異之影響過鉅,暫從略。

利用水泥舖路之成績暨其建築及修養之方法

劉俊傑譯

國際道路協會鑑于今日道路問題之重要,故于1930年舉行第六次會議,曾將舖路材料暨建築及修養等問題,詳爲討論,水泥爲舖路之良好材料,其益處甚多,此次會議中提出研究是項報告者,凡十三國,茲擇其要者譯以介紹于國人,俾供留心道路問題者之參考焉。

水泥之規定

是篇所論及之水泥,係指標準水泥 (Standard portland cement) 及新近發明之快結水泥 (Special or high eqrly strength cement) 而言,至于瀝青水泥 (Bituminous cement) 則未論及。

水泥之普通用途

利用水泥以舖築道路有下列三法:

(1) 造水泥混凝土路基,上舖以他種路面,如地瀝青,磚,及塊石等。

(2) 造水泥混凝土路面,此種路面可用單純混凝土或鋼筋混凝土.

(3) 造水泥粘結之碎石路,此種道路之建築可用下列三法:

(a) 將乾燥水泥與砂之混合物,舖于已做好之碎石路上,用壓路機滾壓後,加水使路面潮濕,再壓之,直至灰漿擠出路面爲止,待凝結後卽可行車。

(b) 將一層水泥與砂之膠漿,夾于兩層碎石間而滾壓之,使膠漿儘量摻入兩層碎石內,滾壓之力,務使膠漿擠出路面爲宜,俾得適當之平滑路面。

(c) 在已做好之碎石路上,澆以薄層之水泥與砂之膠漿,全部滾壓後,再用人工括平。

水泥混凝土路適用于繁重之運輸

前節 (1) 及 (2) 所述之混凝土路基及路面,已爲各國所採用,舉凡城市街道及普通道路之運輸繁重者,均用此種建築。

水泥粘結之碎石路供作輕簡之運輸

前節 (3) 所述之洋灰粘結之碎石路,供作輕簡之運輸,頗見成效,蓋在普通之碎石路中,加水泥粘結,則所能負之載重當較普通碎石路爲大,且此種道路之建築費,較水泥混凝土路爲廉,故在公路建築中頗爲重視。

負載鐵輪車輛路面須用特別計劃

在若干城市中,其道路運輸包括多數重載之鐵輪車輛,水泥混凝土路面所含之普通石料,常易侵蝕,在此種情形之下,水泥混凝土路面宜分爲兩層建築,其上層混凝土所含之石料須異常堅固,否則不足以增加道路之載重量,當建築時,其上層混凝土須在底層未凝結之前,即行鋪設。此種建築,非特能解決侵蝕問題,而其建築費用亦較用他種路面爲省

單層水泥混凝土路適用于繁重橡皮輪車輛之運輸

單層水泥混凝土路中所含之石料,並不須前節所述者之過分堅硬,此種路面如建築留心,厚薄適當,儘足以供繁重橡皮輪車輛之行駛,因橡皮輪對于路面之侵蝕極微,故負載雖重,亦無傷也。

水泥混凝土路面之優點

各種路面之載重,普通以受力層之强度而定。舖面中如瀝青,磚,塊石之用瀝青或砂填縫者,其載重强度甚微,採用之時,恆取其能抵抗侵蝕,減低衝激,使路面平滑,增加觀瞻。但減低衝激,必需相當之水泥混凝土路基以資載重而保存舖面陷裂。故凡取用上述各種路面時,相當之水泥混凝土路基,係必不可少者,且其建造費用亦較他種材料爲省。

路面之選擇,多以使用價值 (Cost of Service) 互相比較而定,其使用價值包含甚多,如建築費及其利息,修養費,路面之生命等,水泥混凝土路建築費少,利息亦少,修養費輕,且生命久遠,故在 1928 年終,美國已有 59,000 哩之

水泥混凝土路,在是年內築成者凡 8756 哩

工程上之監督

水泥混凝土路面及路基之能著成效者,悉恃建築及修養得宜,故工程上之監督,實爲重要。當準備路面時,須明示坡度弧度洩水系統等,對於施工應嚴格及詳細規定,對于材料應有精密之審查。

近來應用水泥混凝土鋪路之實施概況

I. 路基——路基之主要條件,厥爲均勻,泥土之鬆者須雜以他種堅土,使能受力,路基上之排水,應求完美,俾避免路面積水,及從地下水源之溢出,凡普通路面得能保持平滑者,悉賴于路基之適宜,在水泥混凝土路面未鋪之前,路基應常保持潮濕,則水泥混凝土鋪後,凝結時得避免水分之排出。

II. 段面之計劃(路面之厚度)——路面厚度,最少約 6 吋,依理論而言,其厚度應能將所載重量,從路面上分佈于路基,使其總壓力不致超過路基材料之安全載重,昔日築路有用均勻厚度者,有用路之中間較兩旁爲厚者,但近今試驗結果,認爲兩旁較中間加厚之法,最爲經濟,蓋如厚度均勻,則兩旁及露出角等,當較中央部分爲弱,易于侵蝕,路面最適宜之厚度爲中央部分之厚爲兩旁之$\frac{4}{5}$,如是則路面各部份之力量可以一律,至兩旁之厚度,可用下式得之:

$$t=\sqrt{\frac{3\,W}{0.5\,M}}$$

此式中　t = 兩旁厚度,　W = 最大載重,　M = 混凝土之破壞係數

III. 鋼筋及縫——鋼筋之設計,應依車輛之載重而定,若路基穩固,鋼筋儘可不用,否則須用適量之鋼筋,以增加路面之載重力,普通築路,亦有用鋼筋以防止路面因氣候而伸縮所發生之裂紋者。

路面之有縱縫,蓋所以減少不規則裂紋,但普通路面所發現之裂紋,鮮有闊至10呎者;故縱縫之相距當以10呎左右爲宜,沿此縱縫,在相當距離之處,另置短橫鐵條。

IV. 混合及材料之設計——因混凝土建築方面技術進步之故,對于

材料及混合法亦研究愈深切。依近今科學方法，設計混凝土之混合材料時，其比例悉以重量爲標準。標準之限制頗嚴，但以適合地方情形爲原則。至通常所應注意者則爲清潔，硬度，抵抗，氣候之變化及有機物質之附着等。

V. 建築及應用器具——築路之主要條件爲路面平滑，路面之厚度適當，及混凝土之品質等。如欲得良好之結果，則標準及監察務必嚴厲精細，路面之平否，用10呎長之直板試之，其低陷處不得超過$\frac{1}{4}$吋爲限，築路所用材料，均須經過壓力及彈力等之試驗，路面築成後，應行探鑽工作，以定路面之厚度及混凝土之品質。

路面築成後通用之蓋護方法，有下列數種：

(1) 使路面完全沒于水中。

(2) 蓋以潮濕之土，稻草，或粗麻包。

(3) 面上加氯化鈣。

(4) 面上加矽化鈉。

(5) 面上加地瀝青。

上述種種蓋護方法之利弊，常因情形不同而各異，普通公認之最佳方法爲用水。

至于應用器具，舉凡一切鋪路手續，悉用機器施行，以求工作之優良及人工之節省。

VI. 修養——混凝土路面如建築得宜，其修養事簡而費廉，如伸縮縫隙及裂紋發生，應即灌以瀝青等物料，如路面發生解體現象，則須加蓋石料與瀝青之混合物。

IMPROVEMENT OF WEST LAKE

at

HANGCHOW

by

Arthur M. Shaw, Consulting Engineer.

In the absence of written instructions, stating in detail the results which are desired, certain assumptions have been made for the purpose of this report which are based on various conversations and which I believe represent the ideas which have been given. As the entire report is based on these assumptions however, it has been considered desirable that these be stated at the outset, in order that, if the assumptions are in error, the deductions may be corrected accordingly.

ASSUMPTIONS.

1. Outside of the commercial interests of the city, the tourist business (both Chinese and foreign) is of the most importance to the city of Hangchow, not only because of the direct benefits derived but because it is through the arousal of interest of tourists that new business may be brought to this section.

2. West Lake, with its surrounding mountain scenery and points of historic interest, is an absolute essential as a "drawing card" for tourists, and a serious impairment of the lake, by filling, will destroy this most valuable asset.

3. The shallowing process, which has been going on since the lake was created, has now reached a point requiring a general cleaning out if the

characteristics of the lake are to be preserved.

4. It is realized that this general cleaning out of the lake will require the excavation and removal of many millions of cubic yards of material and that the cost of transportation will prohibit the use of any method of disposal involving its removal to points very far from the lake border, thus necessitating the use of some of the excavated material for the creation of new land, within the present boundary lines of the lake.

5. It is desired that, in doing such filling, the present beauty of the lake be enhanced, rather than decreased, the idea being that unsightly angles in the present shore lies will be rounded out but that curved lines will be employed and that straight lines, with sharp angles, will be avoided.

6. The usefulness, as well as the beauty of the lake is to be preserved, due provision being made to continue in service, the openings which provide for furnishing water to the canal system of the city.

HISTORY.

In the study of a project of this nature, it is both interesting and useful to examine its history and the origin of present conditions. There has been no opportunity to examine the written history to any extent though it is recalled that in one historical works, written nearly 700 years ago, reference is made to the intricate network of canals of the city of Hangchow, and that these were supplied with water, through gates, from the lake at the west of the city. From a practical standpoint, the geological history, as evidenced by the soil formations, is of more value than written history could be, for our purpose. From this, it is apparent that the entire flat in the vicinity of Hangchow was, at one time, an arm of the

sea which has been gradually filled up by sediment brought down by the Chien Tang River. Some of this filling has been done during historic times. The original bar, on which Hangchow now is situated, apparently shut off a small area of water, which now forms West Lake. There probably was left a narrow connection with the main river, which has been straightened out later to form one of the principal canals.

Considerable dredging from the lake bottom has been done in the past, both by hand and by machinery, but in spite of this, there has been a continuing decrease in the depth of the lake. It is safe to assume that this shoaling has been caused partially by the usual process, the accumulation of sediment brought down from the higher lands by the streams which enter the lake from the west, but it also is certain that in the case of West Lake, there is another important source, one which apparently is contributing more material than the tributary streams. This other material is the product of decaying vegetation, probably principally aquatic plants. A physical examination of the deposits found in the northern portions of the lake indicate a preponderance of this class of material. It is recommended that studies of this vegetable matter be studied further, by microscopic examinations, with a view to determining its origin, and the species of plants from which it is formed, in order that the trouble may be lessened, if not entirely controlled.

CHARACTER OF MATERIAL IN LAKE BED.

As would be expected, the sub-soil of the lake bed, the material which formed the bottom of the lake when it was first shut off from the river and the sea, is an alluvial clay. This is similar to the "sharkey clay"

which is found in the delta of the Mississippi river and is the same as the sub-soil under the city of Hangchow. Above this clay, is a layer, several feet in thickness of soft material, commonly classed as "muck", which, as already stated in principally made up of vegetable matter, partially or wholly decayed. It is extremely soft, only slightly heavier than water, and when stirred up, it remains in suspension in the water for a considerable length of time. Material of such a nature is easy to excavate, by the use of proper machinery, but most difficult to handle and to convert into good land.

There has been no opportunity for making a study of the material found in other portions of the lake, as was done a few weeks ago of that portion in the vicinity of Pei's Causeway, though it would be reasonable to expect that in the western portion, especially at the rear of Su's Causeway, there would be a greater proportion of silt, and perhaps some sand, To get something of an idea of conditions in that area, I made a trip on foot on Saturday, February lst, around the southern and western boundary of the lake, noting particularly the characteristics of the tributary streams. With one exception, none of the streams entering the lake gave any evidence of scouring their beds or of bringing in course material from the hills. The exception referred to is King Sha Kang, which enters North Lake near Tung's Villa. The deposits in the bed of this small stream indicate that in times of flood, it brings down sand (as its name would indicate) and even small gravel. I doubt however, if much of this coarser material is carried very far out into the lake. The above stream apparently is the most important tributary to the lake. It rises in the mountains to

the west of Ling Yin Temple.

While a careful study should be made of the material to be found in all parts of the lake, in order that the work of dredging may be directed intelligently, I am certain that there will be found no variations in material which would dictate a modification of the general type of equipment as herein recommended.

While it is reasonably certain that some silt, and possibly sand and gravel, are brought down to the lake by the King Sha Kang, it is doubtful if this is a very important factor in the filling of the lake as the methods of agriculture, in the matter of prevention of soil erosion, are far in advance of those of the Western countries and it is not probable that any considerable amount of material is brought in from the cultivated areas. If it is found that soils are being washed from the mountain sides, and being carried to the lake, this would be an additional argument in favor of immediate efforts toward re-forestation of these steep slopes for the various reasons of prevention of erosion, and consequent filling of the lake, restoration of timbered lands, for the use of the next generation, and a beautifying of the mountain sides.

A special effort should be made to determine the origin of the muck upper layer, as an aid in lessening, or eliminating this cause of deterioration of the lake. In this study, a microscopic-botanical examination should be of value. Some acquatic plants can be held in control by annual sprinkling of chemicals on the surface of the water, in quantities not injurious to fish life, while others will not thrive in any but shallow waters. By securing a knowledge of the type of plants supplying the material, a

method of combatting them can doubtless be devised.

QUANTITY OF MATERIAL TO BE EXCAVATED.

As the most of the records which have been consulted in connection with the preparation of this report have used English measures, these will be employed in the following, though in all important matters, these will also be expressed in the old Chinese measures, for convenient reference, and in metric measure, to conform to present official standards.

From available maps, which apparently are sufficiently accurate for preparing preliminary estimates, I find that the lake has an area of 1,400 Acres = 9,300 Mow = 567 Hectares.

The lake ordinarily is held at an elevation of about 3 ft. 10 in. below the general level of the boulevard skirting the eastern shore which lake elevation will be referred to as the "normal" lake level. The following estimates are based on securing a normal, average depth of lake of six ft. = 5.7 chih = 1.8 meters. This will require the removal of the equivalent of 3.7 ft. of material from the bed of the entire lake. The present depth is not uniform though there are no places where the depth is much in excess of three feet. This material amounts to 7,200,000 cubic yards = 1,800,000 fang = 5,500,000 cu. meter.

METHODS OF DISPOSAL.

Owing to the economics controlling the methods of disposal, as already mentioned, it will be necessary to discharge the material at points within a few thouand feet from the point of excavation. I have assumed this economic limit at approximately four thousand feet (about 1,200 meters) though this limit is not absolute. The relative amount of material which

may be disposed of by pumping onto low lands bordering the lake can be determined only by a careful topographic survey, though these are indicated, in ageneral way, on the accompanying map. On this plan, I have indicated more defintely, the areas which it is proposed to fill within the present borders of the lake. These are indicated by letters A to M inclusive and will be of approximately the following area:

Tract	Areas of tracts in:		
	Acres	Mow	Hectares
A	17.3	114	7.0
B	23.0	151	9.3
C	0.9	6	0.4
D	13.6	90	5.5
E	27.4	180	11.1
F	14.3	94	5.8
G	17.5	116	7.1
H	19.5	128	7.9
I	7.4	49	3.0
J	10.6	70	4.3
K	6.9	46	2.8
L	14.6	96	5.9
M	7.7	50	3.1
Total areas to be filled ···	180.3	1,190	73.2

As it will be impossible to predict the amount of shrinkage which will take place when the soft material from the lake bed is placed so that it will dry out and become compact, there can be no advantage, at this time,

in attempting to make an exact estimate of the filling which can be done from the excavated material though it is reasonably certain that there will be a considerable amount of material available for the filling of low lands in the vicinity of the lake, after the areas marked to be filled within the present borders, have been brought up to the required height. For the preliminary estimates of this work, I have assumed that it will require from two and one half, to three cubic yards of excavated material to make one net cubic yard of filling, after shrinkage and subsidence have taken place. This is based on the behavior of similar materials in the lower delta country of the Mississippi river, where, as already stated, conditions are quite similar. After filling operations have proceeded for a few months, observations of shrinkage can be taken which will make it possible to determine conditions with more accuracy, though some shrinkage will take place for several months after the filling has been completed and this must be compensated for by placing all material sufficiently above final established grade.

EFFECT OF FILLING ON STORAGE CAPACITY.

In addition to the necessity for preserving the scenic beauty of the lake, as already mentioned, there should be no encroachment on its storage capacity which might result in its reaching a dangerous stage as a result of excessive storms, or which would lessen the amount of water available for use in the city canals during long periods of drouth. Through the assistance rendered by Rev. E. Cherzi, S. J., Director of the Observatory at Siccawei, and of the Municipal Engineering Department of Hangchow, I have been able to investigate this phase of the subject satisfactorily. Studies have been made of the maximum rainfalls for periods of one day,

one week and one month, it being apparent that the one week records place the greatest demand on the storage capacity and on the discharge outlets. Some changes in the outlets have been made during the past year, but an analysis of the situation shows that there still is an ample margin of safety in these to guard against a dangerous stage of water in the lake, following excessive rainfalls. The small reduction in total area of the lake which is proposed, would have some minor effect on its storage capacity, were it not for the fact that the extra depth which is to be provided will more than offset this. With a depth of six feet at normal stage, it will be possible to draw the water down to a considerably lower stage than has been possible in the past, to provide against extremes of drouth such as was experienced during the autumn of 1929.

CONSTRUCTION METHODS.

Ordinary methods of the control of materials discharged by a hydraulic dredge can not be employed in this case, owing to the very soft nature of the material and its tendeney to remain in suspension for an extremely long time. On the other hand, the hydraulic method of excavation will prove to be much more economical than auy other method which can be employed for doing such work on the scale that is proposed. For this reason, the hydraulic dredging plan is recommended, making special provision for the control of the discharged material. For this purpose, I have planned on the construction of a light, sheet pile retaining wall to be built along the proposed boundary of the tracts to be filled. For the purpose of a preliminary estimate, I have figured on constructing the sheet pile structure by the use of twenty four foot cedar piling, such as can be

secured locally, placing these at three foot intervals and filling in the intervening space with light poles. During the early progress of the work, considerable experimenting with this structure should be carried on to secure the cheapest design which will serve the purpose. It is probable that a considerable saving can be effected over the proposed type by a wider spacing of piles, use of brush and grass in place of some of the poles, and by other expedients. With this pole and brush structure as a core, a mud levee will be constructed which will serve to retain the material which is to be pumped in by the hydraulic dredge, this levee being built up by the use of a grab-bucket dredge described below. Owing to the nature of material encountered, it will be impossible to construct a satisfactory levee without the use of some such a temporary retaining device as has been described.

After this retaining levee has been built up to a helght of perhaps two feet above water level, and has become sufficiently compact to withstand hydrostatic pressure, the filling of the area behind it, by hydraulic dredging, will be started.

If working in sand, or other heavy material, the ordinary process would be to pump into this artificial basin, at one end, and permit the surplus water to escape at the farther end. With the material with which we will be dealing, this method can not be employed as the mud would remain in suspension so long that the most of it would escape back into the lake. To prevent this, it will be necessary to entirely enclose each basin so that precipitation can take place in quiet water. In order that dredging may proceed without interruption, two basins will be prepared

so that as one is filled with mud and water, the discharge may be diverted to the second basin, giving the first one time for sedimentation. When the mud has precipitated, the surplus water will be drained off and the basin again filled.

For cleaning out the Inner Lake, west of Su's Causeway, it will be necessary to make temporary out throngh this causeway to permit the passage of the hydraulic dredge. As this dredging will require several months for its completion, it probably will be found adviseable to construct a temporary wooden bridge across this opening, so as to avoid interference with traffic. In the case of the smaller Inner Lake, back of Pei's Causeway, consideration should be given to the use of the grab-bucket dredge for this purpose, planning its construction to permit its passage under one of the existing bridges, if this is found to be feasible. The grab-bucket dredge will not do this work so economically as the hydraulic but the smaller unit will not be required all the time in the construction of retaining walls and the cleaning out of this smaller lake might well be reserved so that the small dredge can be employed usefully when not required for other work.

CONSTRUCTION EQUIPMENT.

Following are the principal items of equipment which will be required for doing the work as above recommended:

1. Hydraulic dredge with the main pump having a suction and discharge diameter of either I2 or 10 inches (preferably the larger).

1. Grab-bucket dredge with $\frac{3}{4}$ cubic yard "clam-shell" bucket and fifty foot boom.

1. Hand operated pile driver.

A number of mud barges for transporting filling material which will be leaded by the grab-bucket dredge. (These will not be required until the work has been in progress for some time, when it will be possible to determine what type will be best suited to the purpose).

Each of the dredges should be monnted on a steel barge of approximately 24 ft. in width by 50 ft. in length. Exact dimensions can not be determined until an estimate can be secured of tho weight of machinery. The above stated dimensions probably are conservative.

As there are no local concerns equipped for the construction of the dredges, it is recommended that these be furnished complete, by some shipbuilding concern which can furnish a proper guarantee of completion and satisfactory performance.

The small pile driver will be the first piece of equipment required. It should be mounted on a small wooden barge, or on two large sampans, lashed together and decked over by planks. I would furnish complete plans for this so that it can be constructed locally. It would be used not only for the construction of the sheet pile retaining walls but also would be used for setting the poles, out in the lake, for the electric transmission lines and for the construction of trestles to carry the discharge pipe of the hydraulic dredge. It will be engaged almost continuously, on one class of work or another.

CONSTRUCTION PROGRAM.

In any large construction project, it is essential to satisfactory progress and economy of prosecution, that a schedule of procedure be prepared at as early a date as practicable, modifying this as the work progresses, only

to meet unforseen conditions or to improve on methods as planned. A schedule of this nature is especially important in a venture such as this, where the economical and continuous operation of the main unit (the hydraulic dredge) will be entirely dependent on the preparatory work, such as construction of retaining levees, erection of electric transmission lines, placing of discharge pipe lines, etc. All this will require planning of a high order and prompt execution. Unnecessary delays to the dredge will be reflected both in the totsl cost of work and in its rate of progress.

The managers of the shipyards in Shanghai, whom I have interviewed in the matter, estimate that it will require from four to five months to complete the small dredge, ready for operation, and perhaps twice that long for the completion of the hydraulic dredge. This delay in receipt of the main unit will not be serious for the reason, as above indicated, that considerable preparatory work must be completed, and the mud levees permitted to settle, before hydraulic filling is under-taken.

As a preliminary outline, I would suggest the following tentative working schedule:

1. As soon as it is reasonably certain that the work will be authorized, s field party of engineers should be organized for the purpose of:

a.—Securing samples of material from all portions of the lake bed, as I already have done at the northerly end.

b.—Make an instrumental survey of the borders of the lake, iocation of islands and all other features whieh might have a bearing on the work.

c.—As other work may permit, make a complete topographic survey of all low lands bordering the lake which may be considered for imp-

rovement by filling.

d.—Take a complete set of soundings of the bed of the lake. (The soundings which I have been using were made with sufficient accuracy for preliminary estimates but will not be satisfactory for construction purposes).

2. When it is definitely decided to proceed with the work, and provisions have been made for financing it, tenders to be called for the construction of the two dredges and for supplying all auxilliary equipment, such as cables, discharge pipe, pontoons, etc. "Preliminary Specifications" were furnished to possible bidders early in January and they now are in correspondence with manufacturers of equipment. I should have sufficient data at hand to enable me to prepare final specifications not later than the middle of March.

3. In the interim, between the calling for tenders, and before my time would be fully taken up in the inspection of progress of construction of the dredges, I should prepare a construction plan, based on this report as approved, or modified, by the Construction Division, but in exact detail as to location of areas to be filled, the order in which the work is to be undertaken, and other details which must be determined before actual construction can start.

4. Also, during the interim mentioned, I would prepare plans for, and superintend the construction of, the small, floating pile driver.

5. Following approval of the construction program, the field survey party would stake out the first of the retaining levees and the construction of the pile retaining wall would be started.

6. As soon as the small dredge is ready for operation, it would start

construction of the earth levee, along the line of sheet piling. On account of the soft nature of the material, this will have to be done in several repeated operations, permitting the first layer to settle before adding more.

7. By the time that the hydraulic dredge is ready for operation, levees should have been completed sufficiently in advance to permit filling with safety, pipe lines should have been placed and the electric transmission line completed so as to serve the dredge with current.

It is contemplated that the hydraulic dredge will be fully lighted so as to permit night operation but that all other work will be planned only for daylight operation. In an emergency however, any of the work can be carried on at night, to prevent delay to the main unit.

COSTS.

It has not been possible to get an estimate of even the approximate cost of the complete equipment from the Shanghai interests, though they have given me some preliminary figures on some of the elements of the plant. From these data, I am convinced that if any error was made in my original estimate of Mex. $ 200,000.00, it is on the safe side. I would recommend however that financial plans be based on this estimate in order that we may be fully protected, though every effort will be made to hold down the cost of equipment where this can be done without impairing the efficiency of the plant. The above figure is estimated to cover the entire plant cost, including the hydraulic dredge with all necessary piping, the smaller dredge. fully equipped, the small pile driver etc.

The cost per cubic yard of material excavated, will depend, in a large

measure, on the ability and the energy displayed by the Superintendent. With proper supervision, the hydraulic dredge should average twenty hours per day of actual pumping, some time being unavoidably lost in changing pipes, adjusting machinery, making minor repairs and adjustments. While, as noted, the material to be handled will be especially difficult to control as it comes from the discharge pipe, these qualities which have been mentioned will assist in economical excaxation. In ordinary material, such a dredge as has been recommended seldom averages more than about 2,500 cubic yards per day of solid material but, when working in the soft muck, which will form the principal work done by this outfit, I shall expect a daily average of better than 3,000 cubic yards, probably a monthly average somewhat in excess of 100,000 cubic yards. Based on this estimated output, I would estimate the cost of dredging to be kept under five cents per cubic yard, or say $ 5,000.00 per month for all field construction costs, including the cost of operating the grab-bucket dredge, pile driver etc. This figure does not include interest, general supervision and such other items as generally are classed as "General Overhead". It contemplates that a competent Superintendent will be employed, at whatever salary may be necessary to get the best man obtainable, and that he will so organize the work that there will be no avoidable delays to the operation of the main dredge, and that, at the same time, there will be no men employed on the job who are not needed. The Superintendent should be a man of experience in selecting men, in working them to advantage, and in discharging them promptly if they prove to be unfit. Unless this principle is followed, the cost of work will increase and the amount of work done will decrease.

ADDITIONAL WORKS REQUIRED.

In addition to the actual dredging, and the construction of retaining levees (which are an essential part of the dredging program) there will be some additional items which have not been included in the foregoing estimate as they belong, more properly, to what might be termed the "Land Development and Sales" part of the project. These will consist of snch items as shore protection and beautification by the construction of stone or concrete walls, extensions of existing intakes of conduits leading to the city canals, finishing off of the filled areas with a suitable top-dressing of soil from the adjoining hills (or from other sources) and the disposal, by sale or otherwise, of the newly-made lands. All of these items, with the exception of provision for extension of canal intakes, may well bc postponed until after filling operations are well under way.

ADMINISTRATION.

Mention already has been made of the qualities considered necessary in the man who is to be placed in charge of the works. It has been my experience that the best man for such a position can be secured by selecting one who has the proper mental and moral qualifications, plus a good general experience, even if he has not had much experience in the particular work to be undertaken. If it is desired that I should assume the responsibility of designing the plant to be purchased, and assist in getting it started properly, I would recommend that an effort be made to find a man of the type described, preferably with an engineering education, but one who is not afraid to get out into the mud occasionally, as I shall exspect to do; one who is sufficiently mature to command respect; and

one who has not stopped studying just because he left school a number of years ago. It would be my idea that this man be employed at the start, placing him in charge of field surveys at first, but with instructions to "break in" his assistant as promptly as possible so that this second man can take full charge of the surveys at as early a date as this may be required. There should be an unvarying policy of training each man so that he can immediately step into the position next above, on a minute notice, in the event of a vacancy. Following this policy, I would expect the man selected to serve later as Superintendent, would work with me in planning the equipment and in superintending its installation. If he is of the type specified, he would be fully qualified to assume full, responsible control by the time that the plant has been in operation a few months, requiring my sérvices later, in a consulting capacity only. and to an extent which would not interfere with any other work on which I might be engaged.

While the Superintendent should be essentially an "out-door" man, he should have charge of an office in which all engineering data are kept and should have a secretary who is competent to keep all records in proper order. It is assumed that all major purchases, payment of men employed on the job, etc. will be handled through the regularly established agencies of the Province but all such expenditures should be approved first by the Superintendent, and duly recorded by his secretary. Unless this is done, it will be impossible for the man in responsible charge to keep proper supervision of expenditures and, unless these are kept in shape for frequent and convenient examination, it will not be possible for him to correct

errors of operation before serious injury to the prosecution of the work may result.

I have devoted considerable space to this matter of administration for the reason that I consider it one of the most vital matters connected with the project. Next to the proper planning of the equipment, it is the most important.

If it is expected that my services will be employed in the preparation of plans and to assist in supervising the work during its initial stages, it would be very desirable that the Superintendent and, if practicable, his secretary, have a reasonably good knowledge of English. It also would be necessary that I be furnished with an assistant who could do typing and other secretarial work and who would have a good knowledge of English. A knowledge of stenography would not be necessary.

SUMMARY.

For convenience in considering the foregoing report, it may be condensed as follows:

It is recommended that the lake be dredged to as great a depth as is economically practicable (assumed to be six feet), this being done to improve it as a pleasure report; to postpone so far as possible, the necessity of another cleaning out; and to serve as an aid in preventing the further growth of aquatic plants.

A study of the origin of present accumulations to be made, with a view to their future elimination. or at least, to reduce the rate of accumulation.

The amount of material to be excavated is estimated to be approx-

imately 7,200,000 cubic yards.

The new lands to be created, within the present boundaries of the lake will be about 1,200 mow. Additional lands, the area of which can not be estimated at this time, will be improved, these lands now being partially used but not suitable for general purpose on account of their being too low for either general agriculture or for the building of homes.

The total cost of construction equipment (liberal estimate) will be about Mex. $ 200,000.00.

The cost of field operations will be about Mex. $ 5,000.00 per month, or five cents per cubic yard of material excavated.

Arrangements to be made to give the job the very best, most efficient and most intelligent supervision possible.

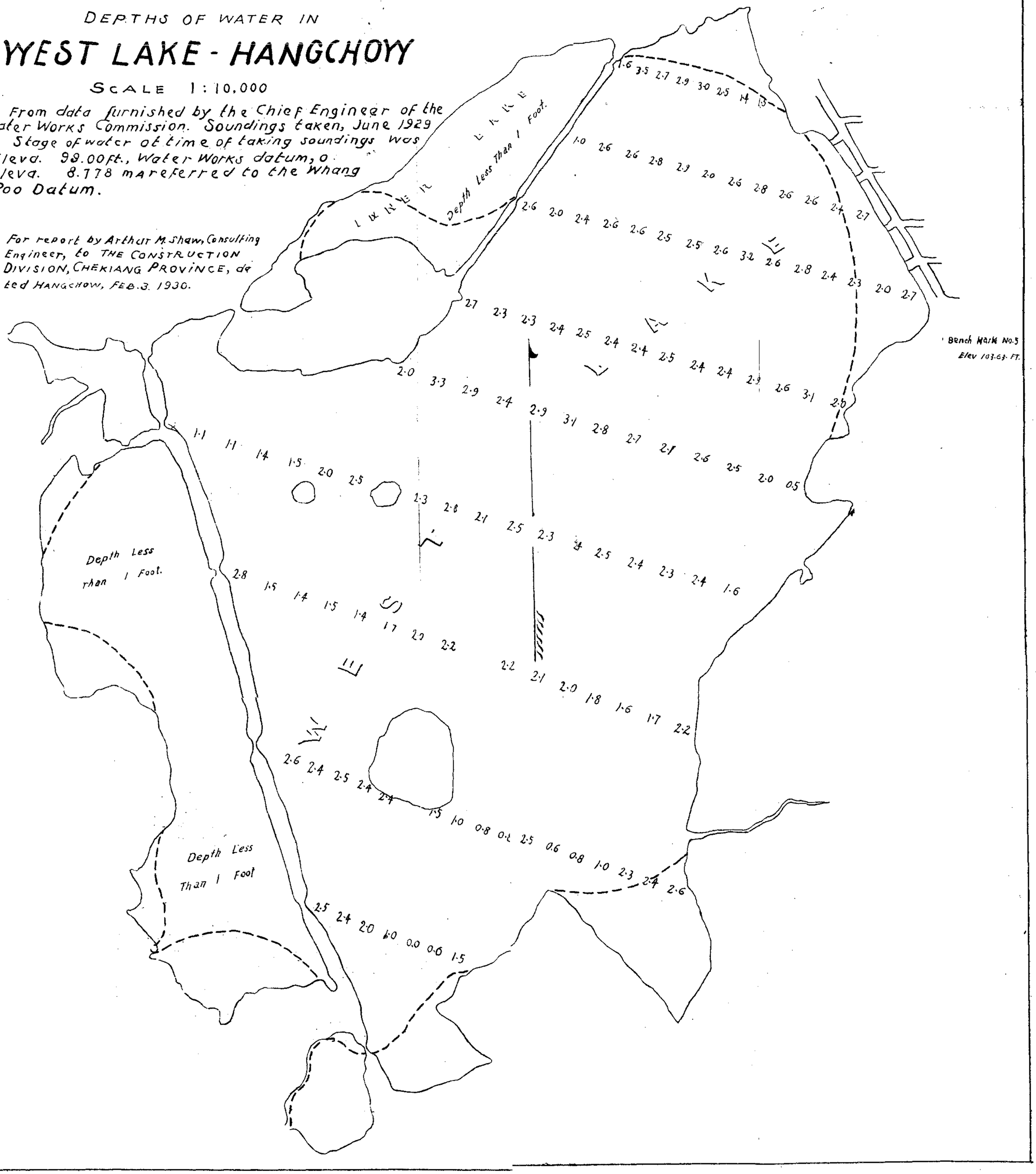
DEPTHS OF WATER IN

WEST LAKE - HANGCHOW

SCALE 1 : 10,000

From data furnished by the Chief Engineer of the Water Works Commission. Soundings taken, June 1929
Stage of water at time of taking soundings was Eleva. 98.00ft., Water Works datum, o
Eleva. 8.778 mareferred to the Whang Poo Datum.

For report by Arthur M. Shaw, Consulting Engineer, to THE CONSTRUCTION DIVISION, CHEKIANG PROVINCE, dated HANGCHOW, FEB. 3. 1930.



測量學名詞之一部 (續)

研究部
戴顎　沈衍基
許陶培　許壽崧

A

原名	譯名
Aberration	行光差
Aerial Surveying	飛機測量
Annual fluctuation	年差
Apex	頂點
Apparent time	眞時
Aqueduct	水道
Astronomical	
A—time	天文時
A—triangle	天體三角形
Astronomy	天文學

B

Barometer	氣壓計
Aneroid—B.	氣壓測高計
mercurial—B.	水銀測高計
Base net	基綫網
Bed of stream	河床
Bolt	栓

anchor—B.	錨桿
Signal—B.	標桿
Broken base line	折向基綫
Borrow pit	土坑
Buoy	浮標

C

Camera	照相機
Chart	圖
hydrographic—C.	河海圖
Chronometer	時辰儀
Civil time	常用時
Contour	等高綫
Culmination	子午綫經過
Current meter	流速計
Curvature	曲率
C. and refraction	曲率和折光
Correction	曲率改正

D

Dial, of Aneroid	氣壓測高計之面板
Direction instrument	平角儀
Discharge	流量

E

Earth,	地球
figure of	地殼外形
radius of	地球半徑

Eccentric station	偏站
Ecliptic	黃道
Equal altitude	
circle of	等高角圈
equation of	等高角公式
method of	等高角法
Equation of time	時差
Equator	赤道
Equinox	赤黃交點.
Expression map	略圖

F

Fixed stadia hair	圖定視距絲
Float	
gauge—F.	浮表
F.—rod	浮桿
surface—F.	浮標
F.—tube	(浮筒),浮管
Focal length	焦點距

G

Gauge	
Automatic—g.	水位自記表?
Hool—g.	鉤尺

H

Hand level	袖珍水準儀
Heliotrope	回光鏡

Hydrographic

H.—maps 河海圖

H.—surveying 河海測量

I

Indeterminate position 未定地點

Index

arm—I. 指臂

I.—correction 矯準數

J

Jupiter 木星

L

Lake surveying 湖泊測量

Least squares 最小二乘方

Leus 透鏡

M

Mean

M.—sea level 平均海平面

M.—solar day 平均太陽日

M.—sun 平均太陽

N

Normal tension 正規拉力

O

Observation 觀察

Observing tower 觀察台

Ocean shore line 海岸綫

P

Perimeter	周
Perspective	透視
Photographic surveying	攝影測量
Pivot	旋樞
Plane table	平板
Pocket compass	袖珍羅盤儀
Polaris	北極星
Primary triangulation	一等三角圖根

Q

Quadrant	象限

R

Reconnoissance	踏勘
Repeating instrument	複角儀
Resection	切點法

S

Sea level reduction	海平矯準
Secondary triangulation	二等三角圖根
Sextant	六分儀
Sidereal time	(星時)
Sounding	水深測量;
Spherical excess	球面餘角
Stake	木樁

T

Tertiary triangulution	三等三角圖根

Three-point problem	三點法
Tide gauge	水位表
Topographical signal	地形符號
Transit	經緯儀

混凝土樑中腹鋼筋排列之圖解法

戴　凱

腹鋼筋 (Web reinforcement) 之作用,卽增高樑之單位剪力;故多利用之以增加樑之負重。其在樑中之位置及數目之多少,隨剪力圖之面積大小形狀而異。剪力圖面積之形狀,分三角形及梯形二種。今茲將二者之圖解法分述于下。

本篇所舉各種作法,皆係參考而得,述者不過加以證明而已。

三角形之圖解法

作法（一）

如圖一,三角形 ABC, 卽剪力之面積,假定分爲五個相等之面積,其法分 AC 線爲五等分,于等分點 $a_1a_2a_3a_4$ 作垂線,相交于以 AC 爲直徑之半圓周上之 $b_1b_2b_3b_4$; 然後以 C 爲中心,Cb_4, Cb_3…爲半徑作弧,與 AC 線相交,得 c_1c_2 …乃于 c_1c_2 …各點作垂線,卽得所求之各等分面積。

證明

設 $a=\triangle Cc_4d$ (面積), $A=\triangle ABC$ (面積)

$AC=D$　　$c_4d=v_1$　　$AB=v_2$　　$Cc_4=x$

解　　$a=\frac{v_1x}{2}$　　$A=\frac{v_2D}{2}$

$$\frac{a}{A}=\frac{v_1x}{v_2D}$$

但　　$$\frac{v_1}{v_2}=\frac{x}{D}$$

∴　　$$\frac{a}{A}=\frac{x^2}{D^2}$$

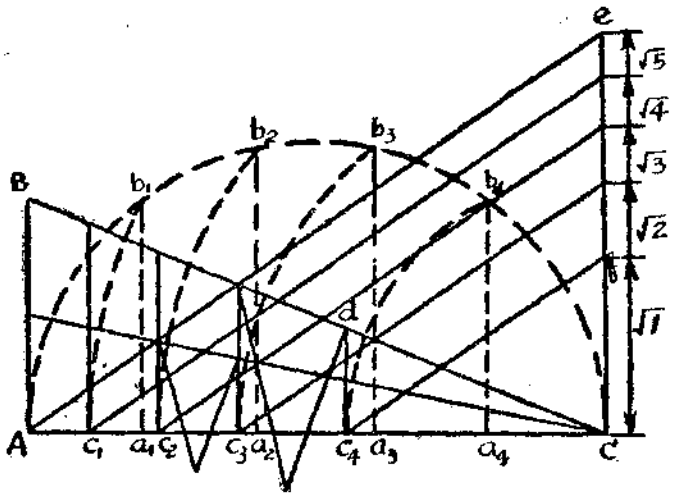
從$\triangle Cb_4a_4, Cb_4A$　　$$\frac{Cb_4}{AC}=\frac{Ca_4}{Cb_4}$$

$$\overline{Cb_4}^2=Ca_4\cdot AC$$

即 $\overline{Cc_4}^2 = Ca_4 \cdot AC$

$\therefore \quad x^2 = \frac{D}{5} \cdot D = \frac{D^2}{5}$

$\therefore \quad \frac{a}{A} = \frac{\frac{D^2}{5}}{D^2} = \frac{1}{5}$



圖一

作法（二）

於 C 點作 AC 之垂線,且以 $\sqrt{1},\sqrt{2},\sqrt{3},\cdots\sqrt{5}$ 之比例分之;連接 eA 線並作平行于 eA 之平行線與 AC 線相交,得 $c_1c_2\cdots c_4$, 再于 $c_1c_2\cdots c_4$ 各點上作垂線,便得所求之等分面積。

證明

由作法(一)已知

$$\frac{a}{A} = \frac{x^2}{D^2}$$

從$\triangle c_4fC, CeA$ $\quad \frac{x}{\sqrt{1}} = \frac{D}{\sqrt{5}} \qquad x = \frac{D}{\sqrt{5}}$

$$\frac{a}{A} = \frac{\frac{D^2}{5}}{D^2} = \frac{1}{5}$$

梯形之圖解法

作法（一）

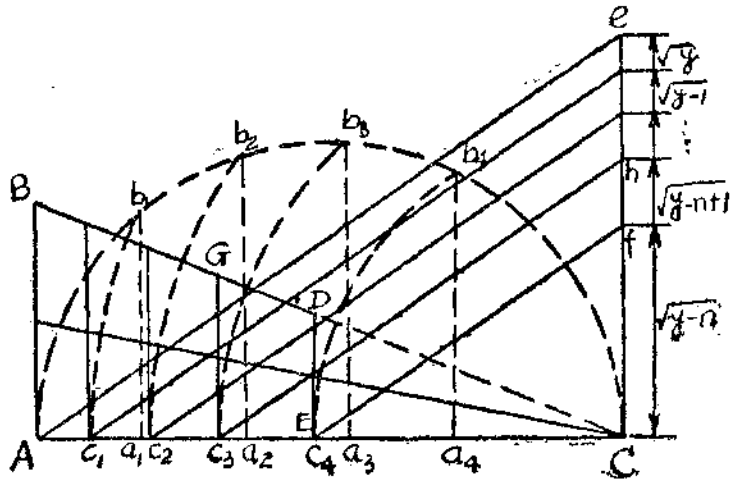
如圖二梯形 ABED 即剪力之面積,假定分爲 4 個相等之面積,其法延長 BD 成三角形 ABC, 以 AC 爲直徑作半圓,乃以 CE 爲半徑作弧,與半圓相交于 b_4點,同時自 b_4點作垂線 b_4a_4,分 a_4A 線爲 4 等分,然後依照三角形解法即得所求之各等分面積（證明全前）

作法（二）

自 C點作 AC 之垂線 Ce,且以$\sqrt{y}$, $\sqrt{y-1}$, $\sqrt{y-2}$…,之比例分之,若設 v_1 v_2, 爲梯形左右之剪力,n 爲等分之數,則

$$y=\frac{n}{1-\left(\frac{v_1}{v_2}\right)^2} \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (1)$$

然後連接 eA 及其平行線得 $c_1c_2\cdots c_4$, 其最後之平行線 fc_4, 必交于E點,可用以校對,再于 $c_1c_2\cdots c_4$ 上作垂線即得所求之各等積梯形



圖二

證明

設 a＝c_3c_4DG 之面積; A＝ABDE 之面積; n＝等分之數

$C_3=x$　　$AC=D$　　$DE=v_1$　　$AB=v_2$

解 以比例法求得　　$CE=\frac{v_1 \cdot D}{v_2}$　　$c_3G=\frac{v_2 \cdot x}{D}$

$$a=\triangle CGc_3-\triangle CDE=\frac{\frac{v_2\cdot x}{D}\cdot x}{2}-\frac{v_1^2\cdot D}{2v_2}=\frac{v_2^2x^2-v_1^2D^2}{2v_2\cdot D}$$

$$A=\triangle ABC-\triangle CDE=\frac{v_2\cdot D}{2}-\frac{v_1^2D}{2v_2}=\frac{(v_2^2-v_1^2)D}{2v_2}$$

$$\frac{a}{A}=\frac{v_2^2x^2-v_1^2D^2}{D^2(v_2^2-v_1^2)} \quad \cdots\cdots (2)$$

從$\triangle Cc_3h$,CeA

$$\frac{x}{\sqrt{y-n+1}}=\frac{D}{\sqrt{y}}$$

$$x=\frac{D\sqrt{y-n+1}}{\sqrt{y}}$$

$$x=\frac{D\sqrt{\frac{n}{1-(\frac{v_1}{v_2})^2}-n+1}}{\sqrt{\frac{n}{1-(\frac{v_1}{v_2})^2}}}=\frac{D\sqrt{n(\frac{v_1}{v_2})^2-(\frac{v_1}{v_2})^2+1}}{\sqrt{n}} \quad \cdots\cdots (3)$$

以(3)式代入(2)式簡單之卽得

$$\frac{a}{A}=\frac{1}{n}$$

爲排列腹鋼筋便利計,以最簡便方法,求小梯形之重心,以定鋼筋之位置.其法分每小梯形之下底邊爲三等分,連接二相對之頂點及等分點,延長相交于一點,由此點作斜線,卽爲所求鋼筋之位置,爲避免二線之交點過遠,則可自中線上作相同之二線,如圖一所示,則其交點甚近,亦頗簡便也.

證明非常簡便,可設 AB, AC, 爲 xy 座標;以兩三角形力矩(Moment)之關係可求每小梯形重心之 $\bar{x}$ 值,再以解析幾何法求線之交點,此點之 x 值必等於 $\bar{x}$,故由此點作 AC 之垂線,一定經過梯形之重心.

應用於土木工程上的地質經濟學

Economics of Geology as apply to Engineering

原　著　Ducley Yorke

譯　者　蔣公魯

引　言

地質學不是一般市政工程師(Municipal Engineers)所詳細研究的課程,而是工程師在實施工程時,因岩石的結構和組織的關係發生妨碍,用以處置的一種學識。這門課程,完全是許多土木工程試驗所得結果的結晶,非一般學生所能獲取,其和市政工程方面最有密切關係的論題,已不列入在內,這課程很易引起研究者興趣,學生研究時,可推廣其本有的智識,而得很大的利益。土木工程中,與這種學識最有關係的爲(一)給水工程,(二)汚水整理工程,(三)道路工程及土工,(四)房屋和橋樑的基礎工程,(五)山洞工程等。下面敘述的,都是說明地質學對於以上所舉幾種工程的價值,雖則都是簡略而粗淺,但作者的意思,認爲確有指出研究的價值。

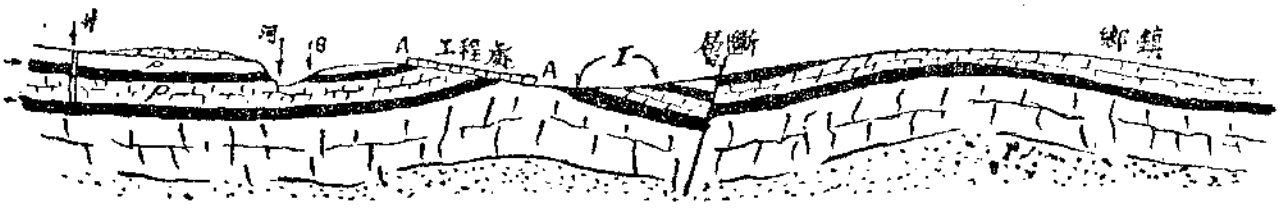
(一)　給水工程

地質學與給水工程之關係,作者已在另一篇文字中貢獻過 (看 The Surveyor, February 28. 1931) 意見,故不再在此地詳述。

(二)　汚水整理工程

陰溝下面地土的組織,苟不預先詳細研究,則工程上面將發生極大影響,尤其是在土地布置預算方面。大概陰溝的設置不宜和日用的水源如泉水,井等相近,因汚水含有毒質,滲透之後,危險很大。故爲避免泉水或井和其他用水與汚水混和起見,在未實施汚水工程以前,研究該地岩石的結構,遂爲一件最重要的事。譬如有一差不多平坦的地方,其地層排列情形,如圖(一)所示:

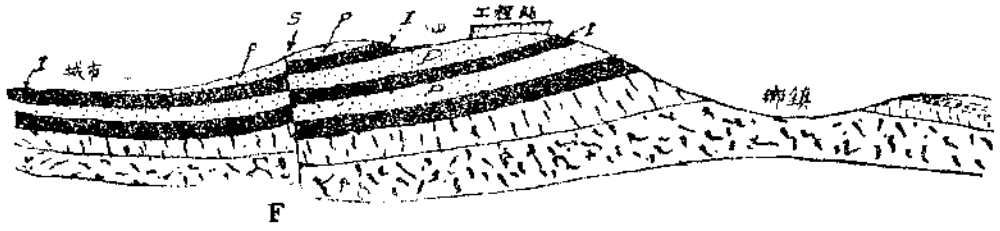
圖 (一)



此地岩石是從工程處向外傾斜,工程處設在一天然小窪地上,在這窪地上,有幾層露出地面岩層橫過。P,P是浸透質或多孔岩,I,I是不浸透質的地層如黏韌性的黏土等。污水在多孔層上受重壓,勢必填塞所有的孔,雖其地面向工程處傾斜而下,然亦能沿不浸透層I,I面上流去.如圖所示,其在上一層的可流入河B而成地面泉水,在下一層的可流入井內.所以這兩處受到影響很大。故對於安放工程處的位置,以在較低而平坦的黏土層上較好,惟在未決定以前,黏土須加以試驗,黏土須有輕鬆的組織,而地層又不宜過厚,如此則污水才得排洩而漸漸流至不浸透層。

有許多很適當的斜坡,爲便於排洩污水起見,將污水集合低處,用抽水機運至較高的整理場所,採用這個方法時,須預防污水與日用水源相混合,設有一工程處在一倭山之巔,山的地層爲凸斜,如圖(二)所示。設城市一旁

圖 (二)



的地層爲一斷層所橫截,污水浸透多孔層P,P後,沿不浸透層I下流,與斷層F相遇。斷層綫上本有沿I,I層流到的地下淤積的水,此水受靜水壓力,就上升到地面,成爲泉水,如上圖所示S處。現在污水亦被斷層所阻而沉積在一處,則泉水被其混濁,爲勢所必至.至圖上所示鄉鎮處,則因地層傾斜的方向

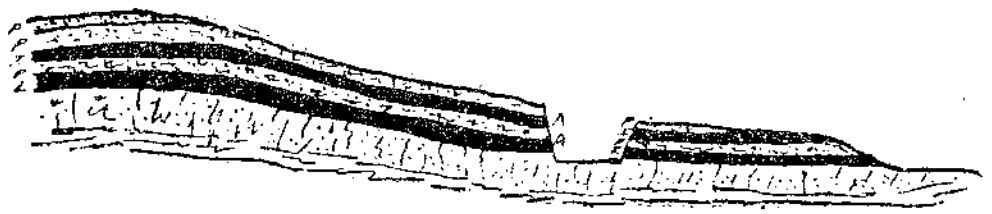
不同,沒有這種危險。

實際上各地的排水法,普通都順着地面上天然的坡度而設施,不過地層的組織每多不能和面層的形狀相同。除非陰溝做得十分緻密,汚水總有漏出的可能,甚或漏出岩層而流到很遠的地方去,使他處的水源變濁。故建築陰溝時,對於陰溝的構造是否有適當的緻密,附近的井水有否受到不良的影響,應該十二分的留意。

(三) 道路工程及土工

當一道路工程或土工要進行時,研究該地的地質,是一件不可缺少的事,開鑿岩石所用的兩邊斜角,不必一定和工程書內所載的穩立角(Angle of Repose) 一樣。因這穩立角不過應用在理想上罷了。這種斜角和下列幾要點到很有關係: (一)地層傾斜角和所截割向方的關係,(二)所開鑿岩石的性質,(三)水和冰凍的作用。若岩石都是軟性而且給合不十分密的,則須開鑿到穩立角爲止;若岩石是厚而且堅的,則須開鑿到差不多垂直角。開鑿岩石最須防備的就是軟硬岩石對於風雨侵蝕的抵抗力不等,如遇這種情形時,應築土臺於硬岩石下面以撐支牠,免致下墜。最不好的情形是橫截傾斜地層的切割,如圖(三)所示,在這種情形之下,多孔層中所含地下的淤積水,

圖 (三)



沿岩石層流到開鑿處 A,A 等地方,結果使軟岩石漸漸的刮落,而留不浸透層岩於單獨不穩定的狀態。這樣以後,軟岩石更加比硬岩石刮落得快,而使岩石有下墜的危險。惟一防禦方法,即用磚石或混凝土做土臺於硬岩石的下面,并留足夠的滲透地位。

在開鑿處的另一邊——圖上A,A的對過——,則除軟岩石外,不論其穩立角情形如何,風雨侵蝕的情形如何,仍能垂直豎立,故其滲透作用很少,或甚至沒有。若切割與地層斜坡同一方向,則滲透作用很少,可與水平面上的岩石同樣開鑿。葉形岩 (Schistone) 和火成岩 (Igneous) 每多裂縫和疊接 (joint),且含多量水分,故易冰凍,而使岩石崩裂,致有大塊的下墜,建築路基,除黏土,砂等外,大多數岩石,都毋須另加特種工作;但如遇輕鬆或軟濕的黏土,尤其是地層薄而且傾斜的,則非設備排水的陰溝不可。如遇有流砂或軟炭等,亦須設備竹條或樹枝編成的基礎,另外再設地下排水制;以負載道路或鉄路的路牀。

(四) 房屋和橋樑的基礎

建築高大房屋基礎,除地面測量和鑽孔試驗等外,對於地質情形,亦需加以精密的研究。假如建築地點是在沙灘上或冲積地上,而建築的底面又不能放到適當深度時,則應建築相當基礎,以分布重量;大概基礎之築在堅厚而傾斜度不甚大的岩石上者,總是十分安全的。韌性黏土,在基礎工程上可算是最好的材料;但須經過鑽孔試驗以觀察是否有砂石層相夾壘,砂石層的性質,對於建築物是有莫大危險,因砂石層含水甚多,一經受壓,其中水份即被擠出地面,使黏土受損而下沉。

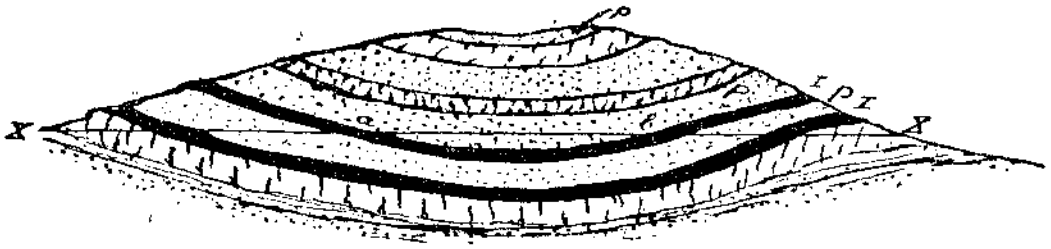
建築物的基礎如在多孔的岩石上,而岩石之下,如有傾斜的黏土層時,則地中之水必由上層而下,至浸透黏土爲止。黏土便受水漸變爲軟滑;且水的爲害又能把軟岩石慢慢的風化,結果乃致不勝載重而發生溜滑和下墜的危險,故建築任何基礎時,對於此點,務使特別注意。

(五) 山洞

山洞工程中,對於地質學識亦甚重要,任何工程師在計劃山洞之前,必先從事於精密的測量及詳究地層組織和岩石性質,以免施工時發生困難,增大費用。在察地層對於山洞穿過的岩石,最爲緊要。如地道沿岩石面的

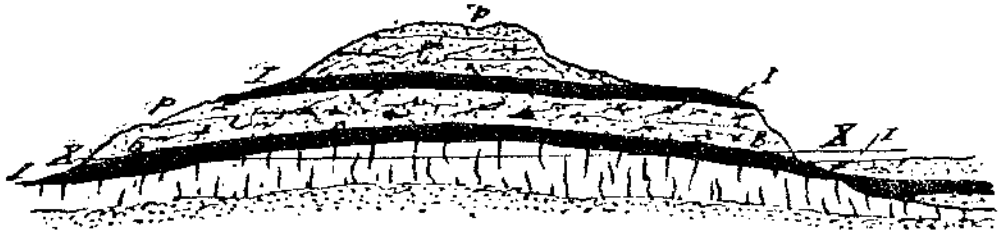
平向通過,則他的性質和排列次序,可在擬定山洞兩端鑽孔觀察而知,大致不至發生任何困難。不過這種情形,不能常有的;故遇地層傾斜時,就非詳細加以研究不可圖(四)圖(五)是表示山洞X—X橫穿凸斜地層和凹斜地層的情形(Antictinal Strata and Synctinal Strata):

圖　(四)



從這種情形中,可看出山洞兩端所開的鑽孔,都不能顯示岩石的眞確情形,就是中間所開的鑽孔,也不能有多大的補助,所以要詳知山洞眞確的地質斷面情形,必須依持岩石結果的學識了。在第四圖中,多孔岩石露出在山洞兩端的地面,牠的下面,排列着不浸透岩石,水沿聯接面a和b流來,浸透岩石漸至不固,當開鑿時,以多用撐柱爲妥。在近山坡的一段,則不浸透岩能自己支持,當然安全;至遇有酥鬆的頁岩時,對於支撐一事很是爲難。圖(五)是

圖　(五)



表示岩石結構最壞的一類,所有的水,完全集合凹斜處或水槽a,致滲透岩石的面積很大,故工作的困難及費用的多少,要看岩石中的含水量,性質及支撐量(Capacity of Support)而定,

結 論

以上敘述中所舉的例,全是很粗淺的,因爲要使理想上的情形,不與基本原則相滲混,故不得不如此.作者已在開始時申述過,我的目的原在披露岩石和地質狀態對於工程設施的重要,使讀者有所明瞭和認識.

北甯路山海關工廠實習記

羅元謙

山海關居北甯路一北平至遼甯,即前京奉路一之中站,形勢險要,爲歷代軍事重鎭,距秦皇島約十七里,水陸交通極爲便利。北甯路于此設一橋樑工廠,修理或製造該路橋梁房架各種鋼鐵建築,及其他一切鐵路工程上需用物件。近以管理得法,兼與他路交易,營業甚爲發達,我國鐵路事業,極爲幼稚,各路雖有機廠之設,而各種設備,莫不限于經費,因陋就簡,以是鐵路上各重要修理,咸借手外人。即細瑣零件,亦需購自外商。時間上及經濟上之損失甚鉅,良可慨也。北甯路山海關工廠于一九二五年八月從英人管理之下,收回主權,以國人長之,大加整理。其設備之完善,規模之宏大,素稱翹楚。以是營業逐漸擴大,東北各鐵路託請定製橋梁者甚多,兼與外商競爭投標,大足爲我國鐵路事業生一光輝。謙去夏承某君介紹,得入該廠實習數月,備蒙熱忱指導,爰將耳目所得,略而記之。唯缺乏系統,又少修辭,不文之譏,不免貽笑大方耳,

在報告實習情況前,請將山海關形勢疆界,作一簡記陳諸閱者。雖于正文無關,然作一地理上之介紹,然後知山海關形勢之險要也。關古稱渝關,今改臨榆縣。東西廣七十七里,南北袤二百十里。東至遼寧綏中縣界十里,遼寧省垣八百里。西至北平八百里,南至渤海十里,北至熱河建耳縣一百三十里,關之東北,循海有道,狹處才數尺,亂山蠻嶺,高崚不可攀越。自關至居庸關,築邊墻二百七十餘處,敵臺三千,長城繞環,護燕蘇爲舊京屏翰,雄關虎踞,傍山海爲遼左咽喉。形勢隘塞,稱最要焉。故歷代據爲軍事重鎭,屯兵扼守,今則雖有火車,嚴防固守,似無所用,然直奉兩戰,概于此決勝負焉。關于遼時,本稱遷民縣。因係晉朝中國流民聚集該處,逐漸成一城市而已。明代以降,知其形勢之重要,故建關設衞,稱重鎭焉。縣無出產,米食來自隣縣,街市全係砂礫,「無

風三尺土,有雨一街泥]其汚穢不言而寓,店舖不多,布疋以日貨爲大宗,亦無戲場茶園正當娛樂處所之設,海邊于夏熱時,盡被外國軍營盤據,鵲巢鳩佔,漸成慣例,日商于車站附近設當舖一,妓館二,旅舍一,洋行二(明賣鴉片,白面,海洛英等毒品,當局漠然亦不取締)日人以卑賤手段,毒害我同胞,其處心積慮之險惡,于此可見。居民約十餘萬,駐兵甚多,以地無出產,供給摩費,以是生活程度較杭城高多矣。

茲將此次實習所得分條如下:

A. 廠之全部觀——(1)名稱(2)位置(3)沿革(4)面積(5)性質及出品(6)組織(7)職員及工人數(8)經費(9)廠之分部(10)建築大概(11)設備大概(搬運,暖氣,通風,等)(12)動力大概。

B. 工作觀——(1)工人採用及取締(2)工作制度(3)工作時間(4)工作程序(5)工作稽核(6)工作記錄(7)材料之購領及收發(8)製品之檢驗及發送(9)機械之修理及檢查(10)工資

C. 廠之分部觀——各房之(1)面積(2)建築(3)工人數(4)工作範圍(5)機器及其他種種

D. 廠外設備——(1)醫院(2)工人夜校(3)輪扶學校(4)工人福利設施(5)員工住宅(6)衞生娛樂設備等

E. 附表

F. 附圖

A. 廠之全部觀

(一) 名稱——北甯路山海關工廠。

(二) 位置——河北省山海關車站北,距秦皇島約十七里。

(三) 沿革——遜清光緒二十年(卽西歷一八九四年)北甯路灤河橋施建完畢,收留歷年訓練之建橋工匠,成立山海關工廠,隸屬北甯路廠務處,屢有擴充;因該路借款英國,故歷屆廠長咸以英人充任,迨民十四年秋,我方

收回主權,始以國人任之;

(四) 面積——全廠地基面積約八萬平方公尺,(square meter)廠屋建築物面積,約一萬二千平方公尺。

(五) 性質及出品——製造及修理各種橋梁,房架,及鐵路上需用物件。主要出品爲鈑梁橋 (Girder bridge), 桁架橋 (Truss bridge) 天橋 (ovethead bridge) 磅橋,轉盤, (Turntable), 房架無線電柱,鐵門,鐵窗,水櫃,水鶴,號誌 (Signal), 道岔 (Crossing), 鐵管,水門,汽門 (Sluice valve), 水泵 (抽水機) (water pump), 號燈,火爐,汽爐,椿架,椿錘,行李車,軋車,平車, (trolley),道釘,螺絲及一切零件等。

(六) 組織——如下表

廠長
- 總務系工程師
  - (1) 文牘 (2) 人事 (3) 統計 (4) 賬務 (5) 工作單
  - (6) 材料核計 (7) 材料收發
- 工作系工程師
  - 稽查
    - (1) 橋梁房 (2) 機器房 (3) 配機房 (4) 鍋爐房 (5) 汽機房
    - (6) 道岔房 (7) 鑄鉄房 (8) 鐵工房 (9) 木作房 (10) 油漆房
    - (11) 模樣房 (12) 號燈房 (13) 號誌房 (14) 建橋隊
- 技術系工程師——(1) 估計 (2) 設計 (3) 繪圖 (4) 材料試驗 (5) 化學化析

附註：總務系各股設司事各若干員,技術系各部設工程員及畫圖員若干人,工作系各房設正副監工,正副工目,工匠幫匠小工學徒若干人。

(七) 職員及工人總數——約一千三百人。

(八) 經費——職員及工人薪資每月約二萬三千元,燃料材料及其餘一切費用不在內。

(九) 廠之分部——全廠分爲十三房一隊,計房分橋梁,機器,配機,鍋爐,汽機,道岔,鑄鉄,鉄工,木作,油漆,模樣,號燈,號誌等十三房,另有一建橋隊。

(十) 建築大概——廠房建築大都爲平房三角式,磚壩,木架,白鉄板屋頂,亦有用鉄架者,各房須用動力傳動機器者,全相毘隣連接,油漆木作模樣

三房,全用手工者,連合一處,翻沙房另居一處,該廠建築遠在四十年前,式樣材料自屬舊式,然外表較差,並無妨于工作效率也。

(十一) 設備大概——窗戶天蓬,均用玻璃,光綫適宜,天熱時,開壁窗以通冷風,屋架支持于成列之衆柱,柱之上部,又支持各軸系及滑輪,藉此以傳達汽機房內蒸汽機所發蒸汽于各房,以轉動各機器,廠房之柱,排成長列,每二列間,裝置機械,亦爲二長列,而中留通路一條,其機械之分布,現各房工作之程序步驟而異,然皆有次序也。房架之下,則有無數引帶,(belt)傳動各機械。若翻沙,木作,油漆,模樣,號燈,鍋爐等房,則無此種軸系及引帶之設置,廠內軌道約有三公里,廠內運搬設備,則有天車(overhead crane)及手車之設備,廠外運搬,則有汽機車(locomotive crane)手絞車,橋車,打風車,大小平車(trolly)等,暖氣設備,則大半祇用火爐,防火設備,則各房俱有自來水管,並備有救火車若干架。

(十二) 動力大概——原動力以蒸汽爲主,亦兼用電力,壓縮空氣,水壓力等;橋梁道岔機器等房機械全用蒸汽力傳動,各房用之電燈,用發電機(D. C. 45 K. W.)供給。鉚釘則兼用壓縮空氣及水力,鉄爐翻沙橋梁三房之化銅鉄,用鼓風機(blower)打風。

B. 廠之工作觀

(一) 工人採用及取締——招募新工或添補缺額,應徵者均施以技能上之考驗,及體格上之檢查,合格者應具保人,塡志願書,入廠試用,再定工資,取締工人法則有五:(1)廠內吸烟者罰工資三日 (2)聚談者停工三日 (3)聚賭者開除並罰十日至一月工資 (4)偷盜者開除並罰十日至一月工資 (5)互鬬者各開除

(二) 工作制度——廠中工作,計分包工制及例工制兩種,包工制卽施行奬金之制,例如一工作標準作量爲x,如能作x+y,則可得奬金,唯所加幾何,視工作而異,此外次要工作,則以例工計,卽做一日計一日工資之制,兩者

各有所長,能並用之,則兼善矣。該廠對于各種工作之標準造出量,極力研究,增加工人工作效率不少,詳見標準造出量及獎金表。

(三) 工作時間——工人每日工作時間最長爲十小時半,最短爲九時半,一年凡變更三次,依季候寒暖而不同:

		三月一日至十月底	十一月一日至十一月底	十二月一日至一月底
上午	上工	六點半	六點半	六點半
	下工	十二點	十二點	十二點
下午	上工	一點半	一點半	一點半
	下工	六點	五點半	五點

上工及下工時,各鳴汽笛爲號,上午六時及下午一時鳴汽笛一次,任工人進廠,至掛至號處取各人號牌,再進至各所屬房掛號,上午六時四十分及下午一時四十分,不得進廠,各房將號牌鎖上,工人遲到不及掛號者,由記工記下,以曠工論,曠工一日,作二日請假計,下工時鳴汽二次,相隔僅五分鐘,工人持各人號牌,掛于掛號處後出廠,每月休息二次,如仍照常工作,可得雙辛。工目無號牌,唯須與工人同時進廠,至監工處簽名。監工及其餘員士,概于上午八時下午二時前進廠,出廠則與工人同時。

(四) 工作程序——該廠各種工作進行,皆有一定程序,以是能整條不紊,工作無論修理或製造,概分常造單及顧客造單兩種,前者限于本路或本廠,而後者爲他處顧客所請託者,常造單由廠長核簽後,交工作系工程師分派各房,承受工作,顧客造單如圖樣說明備具者,與前者手續同,若圖樣說明不備者,或不全者,由工作系作詳細圖樣說明,材料詳表,估計工料,承派工作之各工作房,應于各該工人處,書明何項工作單,開工日期等以便稽查,記工每日常川察究,列單呈報廠長,工作系,及帳房,以便核計工價,及完工日數。

(五) 工作稽核——我國工人,工作效率甚低,雖工作時間假嫌略久,然體格不健全,及怠慢特性亦有以致之也,故工作之稽核,須極嚴密,賞罰並用,

始能挽救此弊,該廠各種工作有急需者,限期竣工,工作進行時,每日由查工將各房工人工作種類實數詳載記工簿上,呈工作系工程師逐日考核,分別執行獎罰。

(六) 工作紀錄——工人有缺工曠工,工作不力或工作超過標準量者由查工逐日記載查工簿上,錄呈廠長核簽後,交帳房于月底發薪時照辦,員士請假日數,若在年例假(即除例假及紀念日外每年可給假十四日)以下者,並不扣薪,亦由帳房記錄之。

(七) 材料之購領及收發——工作系工程師接領工作造單後,令該管監工具立材料領單,送總務系工程師簽字,呈廠長核簽後,到檢關材料廠領取。若無是項材料存儲,應重新另具購料單,送交材料廠代購材料,如已領出或買就後,則由收發司事領取,檢驗質量,簽字于領料單,交材料廠,再將各項材料分發各領料工作房,由各該房首領簽領料單交收發室.

(八) 製品檢驗及發送——每一製品完工時,無論新製或修理,均須施以詳細檢驗,再由工作房,查工司事,及該管監工三面分別入帳後,將製品送交收發室發送。

(九) 機械之修理及檢查——橋梁房終年備有機匠三人,逐年檢查修理及製造備用機件,機器房則每二星期檢查一次,鍋爐房亦二週洗爐一次其他各房較少機件,由各工人留意檢查.

(十) 工資——工人工資以日計,每人每日所得自二角五分(學徒之類)至一元九角(工匠以下)不等.

C. 廠之分部觀

1. 橋梁房(Girder Shop)——該廠主要工作爲修理及製造橋梁房架等,年來二三百尺以內之上桁下桁架橋(Deck and Through Truss Bridge)承造爲數甚多,他如鈑橋(Plate Girder)及工字梁(I—beam bridge)之製造更屬易事,最近有全北甯路加强橋梁(Strengthening bridges)之計劃,(因舊有

橋梁概用E—35設計者,今則都加强至E—50,將原有橋樑加强較諸重建經濟多矣)故該房工作爲最忙繁,工人數之多爲各房冠而其機械之完備,工作之效率,亦稱最著焉。

(1) 面積—橋梁房本身爲66.6×600約3,660平方公尺,放樣平版(Marking-off Floor)爲16×30約450平方公尺。

(2) 建築—平房三角式,磚墻,木架,白鉄瓦稜(corrugated iron)屋頂。

(3) 工人數—約245人。

(4) 工作—製造及修理各式橋梁,天橋,房架,鐵門,水櫃,鉄櫃,鍋爐煙筒及各種鉚釘事宜。

(5) 機器—:

機　名	架數
旋機 Lathe	1
旋轉鑽機 Wall Radial drilling manine	36
風扇 blower	3
鋸機 Sawing machine	6
平板機 plate edge-planning machine	3
直板機 Straightening press	1
直板及彎板機 Straightening of bending roll	1
衝剪及切角鉄機 Punching and Shearing and angle-cutting machine	5
水壓鉚釘機 Hydraulic riveter	7
天車 (overhead crane)	10

天車計有三噸者五架,五噸者四架,及十噸者一架,其長度約爲30呎。

各機之工作及形狀略述之如下:

鑽機乃用以鑽鋼鐵件之孔者,置鋼件于機之一平面上,用螺旋夾緊之有兩鑽孔桿 (sdindle) 旋轉其上,桿之下端,各有鑽刀一,緩緩旋轉而下,離鋼

件不遠,對準孔眼後,始下端穿過鋼件,則得一整齊之孔矣。衝孔機用以衝孔之用者,機有一鋼製衝頭,(punch)上下升降,及其下降時,伸入其一鋼製衝模(die),凡欲衝孔時,須將鋼件上所定之孔眼,對準衝模,平置于衝模上,則一動掣柄,衝頭卽下衝穿過孔眼,而落圓片于衝模內,衝頭視孔眼之大小而更換之,凡衝出之孔,不及鑽穿者之整齊準確也。剪機與衝孔機相似,所不同者,在無衝頭,而有一鋼刃 (blade) 上下起落,落下與另一不動之鋼刃相切,與普通剪刀作用相同,鋸機爲圓形鋼輪,沿邊有齒,置鋼件其旁,鋼輪轉動,則鋼件鋸成二段矣。鋸機所切鋼件面,較削切機所切者光滑,略加磨挫,卽可應用,而削切者,須挫光磨平,費時甚鉅也。平鈑機者,用以修平鋼鈑之邊沿者。直鈑機者,用以平直鋼鈑之彎曲者。機有一鋼架,上有大滾筒(roll)一,置鈑于二者間,滾筒轉動時,同時推進鋼件,則彎曲部分平直矣。水力鉚釘機,具二指對立,鋼件孔眼內已放燒紅之鉚釘後,置此二指間,一開掣柄則水力推動二指,緊壓鉚釘,則無頭處成一半球式之釘頭矣。

(6) 其他種種:

放樣平鈑(Marking off Floor)在橋梁房外,有一用數鈑鉚接而成之大版,爲 30×16 長方形,用以照圖樣尺寸一樣大小繪粉綫于此版上者,無論何種鋼鐵建築,由技術系描繪工作詳圖 (working drawing) 後須交此處,用實足尺寸畫出,所以如此不憚繁費者,因鉚釘關係于建築本身甚鉅,鋼件之連綴,全仗鉚釘作用,若釘孔稍有參差,卽不能拼合成形,全部卽成廢物,圖樣上之尺寸,縮尺不大,不易校驗,故爲妥妥計,須先畫樣圖如本樣大小,將各釘孔一一列出,各部份可拼合較量,圖樣上之差誤,卽可察出改正,如此詳細繪出檢視後,再以之拼製,自可適合無差矣。 (未完)

民二二級土木科暑期測量實習記

劉　楷

七月四日晨七時許,余儕偕吳沐之先生暨夫役等共四十餘人,攜儀器,行李及一切應用品,由汽車赴六和塔之江文理學院,開始暑期測量實習,之江離城僅二十餘里,未幾即達,各將寢處佈置就緒,午膳後,即行回城,蓋本級同科邵君本惇,適于是日與王女士于湖濱舉行婚禮,我儕均被邀,婚禮頗盛,至晚十時始返。

我級本科同學共三十三人,除女同學得校中許可免習,及邵君因新婚蜜月,未得參加,鄭君因故不習外,尚有民二一級補習者七人,共三十六人,計分六組如下:

第一組　許陶培,(組長)沈衍基,王文煒,金培才,徐益範,

第二組　蔣公魯,(組長)曹秉銓,杜鏡泉,葉震東,夏守正,譚慰岑。

第三組　劉　楷,(組長)惲新安,洪西青,吳錦安,徐仁鏘,梁冠軍。

第四組　李宗綱,(組長)戴　顗,潘圭綏,沈其洪,丁同義,王恩洽,

第五組　陳允冲,(組長)趙祖唐,張農祥,王之炘,許壽崧,宋雲盛。

第六組　潘碧年,(組長)錢元雋,李恆元,陳乙彝,任彭齡,湯辰壽,張德錩,

五日晨,教授李紹熹先生由城中來,將所有工作規定如下:

Important Topics on Topographic and Hydrographic Surveying of camp

1. Test instrument assigned.
2. Selecting and Marking triangulation stations and B. M. S.
3. Base line measurement and corrections.
4. Measurement of angles (Horizontal and Vertical).
5. Establishing B. M. S. (precise and ordinary leveling).

6. Astronomical determination of base line between triangular stations.
7. Connecting traverse with triangulation.
8. Adjustment of triangulation.
9. Plotting triangulations.
10. Filling in topographic details.
11. Hydrophic surveying.
12. Mapping (Topographic and Hydrographic).
13. Testing instrument to be handed in.

約分五步:

I. 踏勘及定三角站及水準標誌。

II. 測定基線,三角網及水準。

III. 測定導線及水文測量。

IV. 測定詳細地形。

V. 繪圖。

晨七時,各組長分配儀器後,即分別檢驗,有錯誤者設法較準,九時許,出發踏勘,每組各派二人參加,由李吳二先生領導,至預定之測地大慈山與玉皇山等處,距之江約二里許,地形複雜,山巒重疊,溪澗映帶,爲一良好之實習場所,時烈日懸空,炎熱異常,攀山越嶺,汗流浹背,加之野草高可沒人,舉步爲難,幸各同學俱勇往直前,不畏艱苦,但進行遲緩,日已晌午,所勘定之三角站及水準標誌僅各六,而飢腸轆轆,不得不暫告段落,歸而進餐,迨紅日稍下,即架三角架(Tripod signal)。

跋涉終日,過于勞頓,至晚均感疲乏,希早得安息,但天氣炎熱,不能入睡,同窗三五,踱踱江頭,藉消溽暑,錢江風光清麗,遠勝西湖,胸襟甚爽,時過午夜,方相偕歸寢,酣然一覺,醒來已六時矣,是日天忽雨,工作遂停。

七日,雨雖停,而陰沉未減,然我儕不之顧,毅然出發,未幾,一輪紅日,透出雲隙,光芒萬丈,與浪濤澎湃相掩映,美趣天然,衆皆喜出望外,工作益力,今日第一與第二兩組量基線並測子午線,第三組測精密水準,第四五六三組測普通水準,每組除上述工作外,另分派一人,由李先生領導,繼五日之踏勘工作,連上次共設三角站八,水準標誌八,至此第一步之踏勘,定三角站及水準標誌始畢。

第一水準標誌與第二水準標誌在第一三角站與第二三角站附近,(水準高度依浙江省水利局之金童橋水準標誌爲準),用精密水準測之,因三角網之基線,卽用第一與第二三角站之距離,其錯誤關係全部測量甚大,故須格外準確,余等依次自金童橋沿杭富公路前進,路面平坦,測量極易,但工作時雖爲謹愼,在儀器轉換點之前後視距,亦未超出規定之三百呎以外,然結果所得之連合差 (Error of closure) 竟達 0.10 ft 之巨,照連合差公式,(0.017$\sqrt{\text{miles}}$ ft.) 我等所測之距離,僅四千呎,則所應有之最大連合差,當小于 0.013 ft., 其相差所以如是之大者,蓋是日西南風甚急,以致使用長自讀標尺 (Long self-reading rod) 時,每不易穩定,取讀呎時,甚爲困難,故有如許之錯誤也。

八日,第一組在三角站讀平面角及直面角,第二組測精密水準,第三組測子午線及量基線,第四五六三組仍繼續昨日之水準工作,出發時天氣晴朗,至九時前後,四面浮雲,卽層層推上,將日光遮蔽,于是欲測子午線者,祇能停止,蓋欲得比較準確之子午線,必候太陽升高至其直面角大于十度時方可,因在十度以下,大氣之折光矯正數(Atmospheric refraction correction)無定,所得結果,殊難準確,午前午後,則直面角過大,爲儀器所限制,故以上午九時附近,最爲適宜,今日機會不佳,祇能留待他日補測。

基線卽用三角站 T_1 與 T_2 之距離,測量時依尋常量基線法量之,惟第一次所得結果,均較其他五次爲長,此因鋼尺受拉力及溫度之影響,而伸長

所致,下午作計算及校正基線之長度。

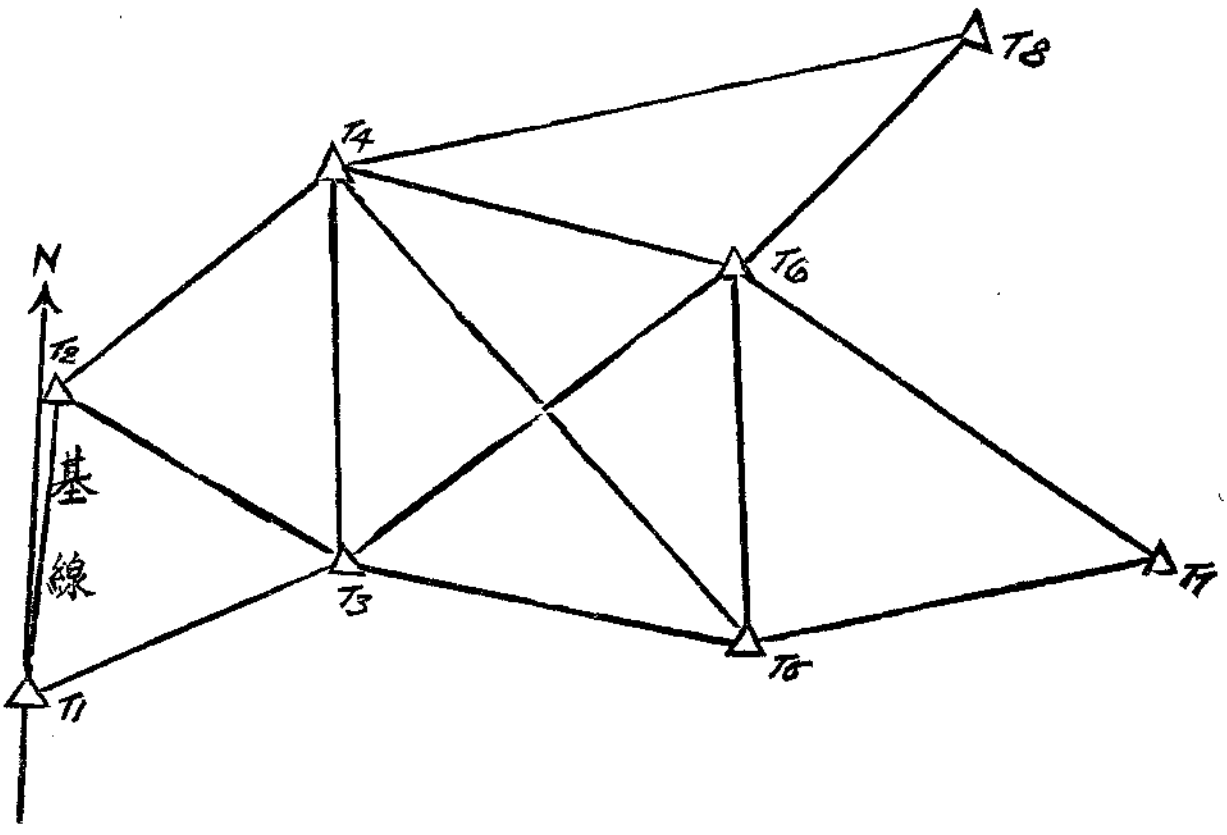
我儕至之江已四日,在校時所欲藉暑期而練習之游泳,此數日中,因氣候不佳,未能如願,今日雖不過熱,但已有數人入水,余因不諳水性,又因勞倦,未敢一試。

九日,第一二三三組,測普通水準,第四五二組,量基線及測子午線,第六組,測精密水準,凡測普通水準者,其標誌有在山巔,有在山麓,地形變化甚大,測時費時亦多,今日天氣殊熱,山谷中草長風寂,氣悶非常,忽然黑雲重重,自西南漸來,繼而日色無光,狂風驟至,知將大雨,有議歸計者,猶預不決,遠望錢江,雨如瀑下,隱約可聞,未幾,大雨果至,遂作臨時標記,以便次日續測之用,冒雨而返,衣履盡濕。

十日,第一二三三組,仍續測水準,第四組測三角網之平面角與直面角,第五組測精密水準,第六組量基線,夏雨初晴,天氣開朗,精神殊爽,預計今日工作,必不能于午前完畢,遂預購乾糧,以備充飢,但未及晌午,而所備乾糧已罄,工作進行特別迅速,本預定至少三時許方可完畢者,二時已全部竣事矣。

十四日,天始晴,有未測三角網之直面角與平面角及補測複測水準者,定近數日內結束。

十五日,天陰,未能出發,八時李先生召集同學,假之江教室,將各組所測得之結果彙齊,備作校正三角網之用,並詳細說明校正三角網之方法,我等,



所測地形之內,共有三角站八,計有平面角二十八個(如上圖)校正時每一次分兩種,一爲測點校正, (Station adjustment) 卽每站所有之角之和,必須等于三百六十度,一爲圖形校正 (Figure adjustment), 卽在三角網中,每三角形三角之和,須等于一百八十度,此二種皆用平均分配法校正之,一次校正,所得結果,決不能完全適合此二種條件,必須作多次之校正,使其差數愈小愈好,我等所得結果,至六次校正後,已無大誤。

四邊形之校正亦分二部,一部用角校正 (Angle adjustment), 一部用邊校正(Side adjustment),經此二法互相校正多次,使其適合所要求之準確數爲度。

十六日,兩組測導線,兩組水文測量,其餘兩組留舍校正三角網及計算三角網內各三角形之邊長,並將各該組地形測量時分配地帶之必要線網,用坐標(卽用縱距Latitude及橫距Departure)畫于紙上,以備將來製圖之用.

在測導線時,每導線站 (Traverse station) 之位置應極爲審愼選擇,一方須顧及地形之變化,一方須顧及儀器之能力,以能將附近地勢及房屋等之完全測得者爲適宜,如面積太大,可預定副樁(Sub-station)之位置,以便測地形時之用。

導線每邊之長短,用照距法 (Stadia method) 讀出,每導線站之高度,從相連之兩導線站,以水平線所成之直面角算出,在工作時同時須將導線之眞方角 (Azimuth) 讀出,用以計算導線各邊之縱橫距,因地形測量區域太大,一導線不能包括者,可將測區分爲兩部,每部各定一導線,余組今日祇完成一導線。

下午室內工作,爲計算導線之縱橫距。

二十一日,在前數日中,有測水文者,有測導線者,有在室內計算及繪圖者,水文測量祇需二日,由兩組同時工作,一組在船上,一組在岸上,所欲測量者爲岸線,河深河牀之形狀及水流速度等,在岸上之一組,用經緯儀二,在三

角站上定船之位置,並同時記標記(旗色)及時間,以便校對,在船上之一組,使船行駛在所定之標準直線上(Range line)在相等定距內,測河深一次,同時揮旗鳴笛示標記,並將時間記下,岸上組卽可于此時讀船位角,如此往返凡兩次,晨七時許,正潮水高漲後,水流不急,故船能在所定直線內行駛至十時前後,潮退水急,舟易歪斜,且近望日潮汎更大,更爲困難,及測抵彼岸去原定標桿,可百餘呎,繼測水流之速度,係用拍拉斯流速計 (Price current meter) 採一點測流速法,(Single point method)因水流急,工作甚爲費力。

二十二日,因天雨,改作室內工作,繪錢塘江之岸線及斷面圖,及計算流速。

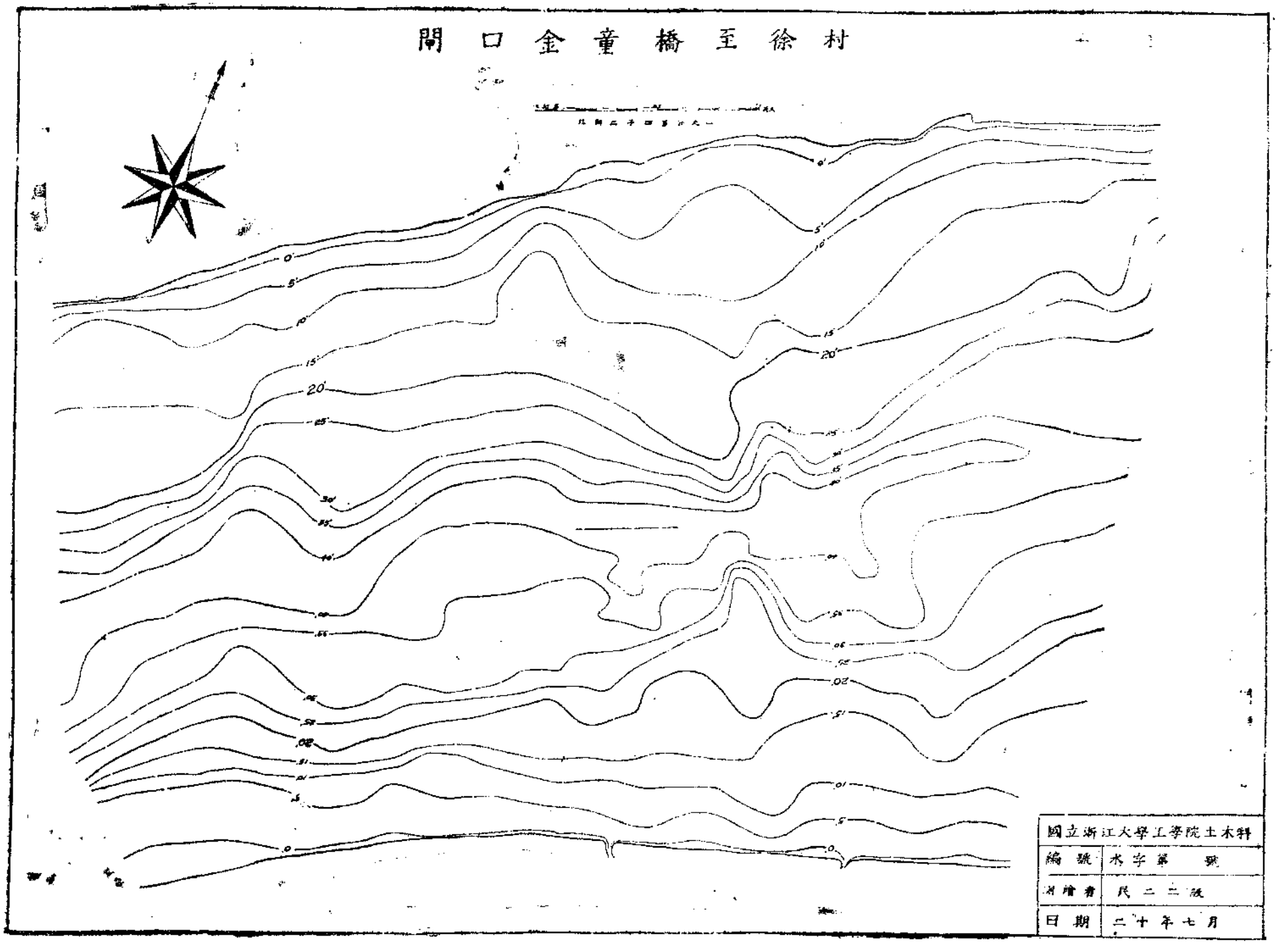
二十三日,重測或補測導線,或計算導線之縱橫距,第三部工作,今日始畢,近日天氣高佳,作水文測量時不覺炎熱,惟測河深時,鉛錘起放頗勞,且衣履盡濡,殊覺不適。

二十四日起,各隊均作地形測量,預定四日內完畢,凡地形複雜,山嶺重疊之處,用經緯儀及照距標尺測之,在較小之山丘或平原,則用平板儀及照距尺測之,較爲省便,但費時較多,于天氣不佳時,工作甚爲困難,故此次用平板儀之兩組,較用經緯儀者稍遲。

所繪之圖共二,卽錢塘江底平面圖與大慈山之地形圖,前圖已于水文測量後繪竣,故祇餘大慈山地形圖,所用比例爲一千二百分之一,並十呎等高線,所有大部時間,均費于連結等高線,因地形頗複雜也,鉛筆底圖旣竣,凡山水樹木房屋等用顏色不同之墨水區別之,然後匯合各組繪于複印紙上(Tracing paper),至此全部工作,乃告完成,一月辛勤,祇此二圖,彌可貴也,特附載于後。

全體同學教師及夫役等,均于七月一日返校,此一月中之生活雖甚勞苦,但經驗上得益非淺,因草是編,以留鴻爪。

錢塘江江底平面圖



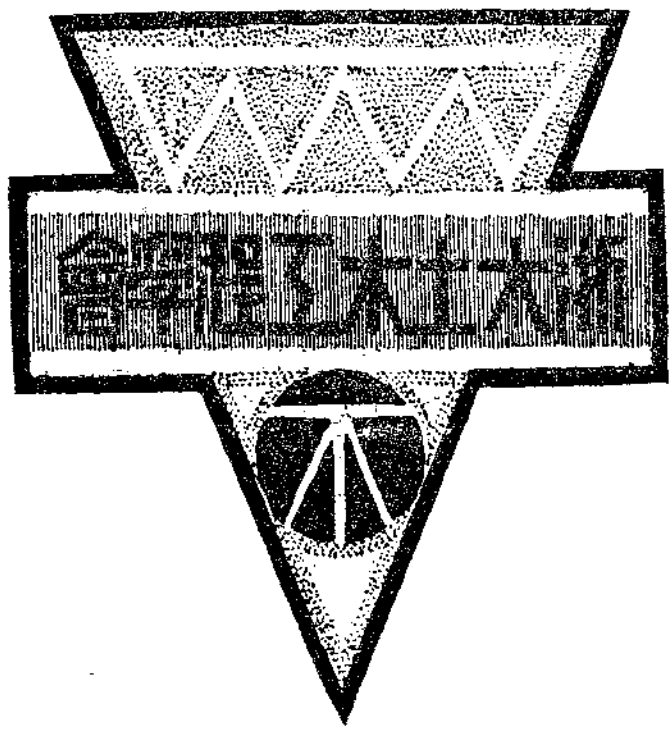
杭州大慈山地形圖

國立浙江大學工學院土木科	
編號	地字第　號
測繪者	民二二級
日期	二十年七月

本會近狀

本校自民國十六年秋開辦土木工程科,至今將五載,本會于十八年秋成立,至今亦將三載,本科同學（即本會會員）,至今共一百三十一人,在校者九十八人,已畢業者十四人,中途離校接十九人,茲將調查所得,畢業會員之服務狀況錄後:

姓　名	服務狀況
吳光漢	上海滬浦工程局
劉俊傑	天津華北水利委員會
茅紹文	上海市土地局
徐邦甯	浙江省公路局
丁守常	浙江省公路局
羅元謙	本院助教（現任江西省公路局未詳）
顏壽會	上海市土地局
陳允明	山東小清河工程局
翁天麟	上海市工務局
高順德	杭州市自來水廠
葉澤深	福州理工中學
湯武鈱	蘇州太湖水利局望亭流量隊
胡鳴時	上海愼昌洋行建築部
孫經楞	江蘇導淮委員會



本會會徽,已于本年四月十五日常年大會通過其式樣如右。

上圖係將徽章放大三倍,四邊爲銀質之底板,上端三角架,示鋼架橋樑,爲青灰色,以示鋼鉄之意也,鋼架四周爲深藍色,下端示一測量儀器,本身爲橘黃色,四周圓形,內爲銀質白色,圓形外爲青灰色與深藍色。中部爲鋼軌,亦青灰色,會名以黑色刊于其間,四周以黃色。

會徽式樣之徵求,曆半載餘,採用者爲國立藝術專門學校,邱玺君所設計。

本屆理事

洪西青 吳錦安 李恆元 李兆槐 淩熙曆 戴 凱 金學洪

徐世齊 姚寶仁 馬梓南 粟宗嵩

本屆職員

總務部長 洪西青

文牘 馬梓南

會計 姚寶仁

庶務 粟宗嵩

研究部長 徐世齊

譯述主任 徐學嘉

實習主任 戴 顗

參觀主任 李兆槐

講演主任 淩熙曆

調查部長 李恆元

地質調查 朱立剛

材料調查 劉 楷

規章規章 許陶培

編輯部長 吳錦安

編輯主任 李春松

事務主任 淩熙曆

編　後

我們非常慶幸,在國難期中,本刊二期居然出版了。這固然是本會同仁努力的結果,但非得贊助各位先生的輔導並惠賜宏著,恐怕現在還不能出版,所以在這裏致無限的謝意。

本刊雖非定期刊物,可是希望牠進步得和定期的一樣。——每學期出版一次,不過爲着經濟和其他種種關係,致第一期和第二期相隔了兩年,有幾位先生的大作,也給我們耽擱得快兩年才和大家見面,非常的抱歉,只好請那幾位先生分外原諒。

同人才力菲薄,在這裏,難免有許多欠缺,甚至謬誤的地方,所以希望大家加以原諒和指正,使本刊得逐漸改進的機會,那是非常感激的。

勘　誤　表

頁數	行數	字數	誤字	正字
7	22		filler	filter
8	9		lador	labor
8	9		radid	rapid
8	22		apparatu	apparatus
10	12		bazovd	hazard
10	13		insurancerates	insurance rates
11	7		systms	systems
20	10	8	Safety	Safe
23	20	5	whish	which
24	3	7	Convegence	Convergence
26	2	8	turtine	turbine
30	24	3	$\frac{l}{r}$	$\frac{l}{r}$
35	表二		小青磚 | 396 $\#/\square''$	小青磚 | 1396 $\#/\square''$
37	7	12	eqrly	early
39	23	2	闊	相隔
48	13	5	thougn	though
49	16	5	tendeney	tendency
49	18	8	auy	any
51	6	6	throngh	through
52	7	3	tho	the
53	8	7	totsl	total
53	19	1	s	a
53	22	12	iocation	location

頁數	行數	字數	誤字	正字
53	23	7	whieh	which
56	7	6	excaxation	excavation
57	25	2	exspect	expect
60	5	8	purpose	purposes
64	14	1	u	n
69	13	2	3	C_s
78	1	16	寓	諭
80	6	26	現	視
81	6	26	號	牌
81	9	10	號	牌
81	12	6,7	至號	牌
83	25	6	Sdindle	Spindle
85	2	9	由	乘
85	15	8	悪	悪
86	7	1	Hydrophic	Hydrographic
86	19	16	汁	汗
87	12	6,7,26,27,	連合	閉塞
87	13	26, 27,	連合	閉塞
87	24	29	仲	伸
90	19	13	結	接
91	4	17	接	者
92	23		規章規章	規章調査

土木工程

THE JOURNAL OF THE CIVIL ENGINEERING SOCIETY UNIVERSITY OF CHEKIANG

總發行者
浙江大學土木工程學會
地址
浙江杭州大學路

本刊定價
每期定價大洋二角

浙江省立圖書館印行所承印

國立浙江大學工學院工場出品

▲出售日常用品

▲定製各色機件

一、絲棉織品：五彩棉織風景，五彩喜壽字，五彩大毯子，風通大毯子，各式花呢布，各式毛巾布，各式柳條布，各式斜紋布，各式平布，絲棉紗羅織物，各式軟緞，大綢，華絲葛，等

二、化裝用品：化裝肥皂，洗衣肥皂，香水，花露水，等

三、精製皮件：牛皮公事包，羊皮公事包，皮箱，皮夾，等

四、定製機械：發動機，製罐機，吸水機，織布機，染洗機，車床刨床，及各種木質模型，五金製品，等

五、代客漂染：定染各色綢緞布疋及衣服拆片，

六、修配各種機件：出售無綫電收音機及乾電池，等

其他名目繁多，不及備載，倘蒙　賜顧，請向本院經售股接洽，無不格外克已！

（地址）杭州大學路　（電話）二三二八