西城五区张

長江三峽水利樞紐

The Three Gorges Project

概　述

General Description

长江是中国第一大河，全长6 300余公里，流域面积180万平方公里，多年平均径流量约1万亿立方米，河流长度和多年平均径流量均居世界第三位。

新中国成立以来，为了治理开发长江，开展了大规模的勘测、规划、设计和科研工作。1958年编制了《长江流域综合利用规划要点报告》，通过全面规划，论证了三峡水利枢纽是治理开发长江的一项关键工程。

长江自奉节至宜昌长约200公里的河段，穿越瞿塘峡、巫峡、西陵峡三段大峡谷，三峡即是这三大峡谷的总称。举世瞩目的三峡水利枢纽位于西陵峡中段。坝址选定在湖北宜昌三斗坪，下游距葛洲坝水利枢纽约40公里。坝址河谷开阔，基岩为坚硬完整的花岗岩，具有修建混凝土高坝的优越地形、地质和施工条件。坝址以上流域面积100万平方公里，水量丰沛，多年平均径流量4,500余亿立方米。

三峡水利枢纽具有防洪、发电、航运等巨大的综合利用效益。1958年长江流域规划办公室编制了《三峡水利枢纽初步设计要点报告》，推荐选用三斗坪坝址和正常蓄水位20[illegible]米的方案。嗣后，对三峡工程继续进行了大量的设计研究工作，包括不同正常蓄水位和坝址的比较研究。1983年，长江流域规划办公室根据新的情况，编制了正常蓄水位150米的《三峡水利枢纽可行性研究报告》。随后，根据国务院批复，按正常蓄水位150米，坝顶高程175米进行初步设计，1985年完成《三峡水利枢纽初步设计报告》。由于三峡工程规模巨大，各方面对三峡工程建设以及正常蓄水位方案仍有不同意见，因此决定进行补充论证，并重新比较正常蓄水位150～180米的方案。通过论证，推荐正常蓄水位175米方案。

The Yangtze River(Changjiang) is the largest river in China. It is 6300 plus km long, with a drainage area of 1.8 million sq km, yielding a mean annual runoff of some 1000 billion cu m. Both in length and in mean annual runoff it ranks third in the world.

In order to harness the river and develop its water resources, extensive efforts in investigation, planning, design and scientific research have been made since the founding of our People's Republic. In 1985, a report entitled "Planning Essentials of the Yangtze Valley Comprehensive Development" was completed. By this overall planning the Three Gorges project was proved a key to the exploitation of the river.

The stretch from Fengjie to Yichang, about 200km long, cuts through such three majestic canyons as Qutang Gorge, Wu Gorge and Xiling Gorge—known as the Three Gorges. The Three Gorges project, which is now attracting worldwide attention, is located in the middle of the Xiling Gorge, about 40km upstream of the Gezhouba project, with its damsite at Sand-

三峡工程地理位置圖
Geographical position of the Three Gorges

General Description

ouping in Yichang, Hubei Province. At the damsite, with a rather wide valley, and a sound and intact bedrock of granite, the topographic, the geologic and the constructional conditions are excellent for building a high concrete dam. It controls a catchment area of 1 million sq km, and water resources there are abundant every year, wtih a mean annual flow of 450 billion cu m.

The Three Gorges project has tremendous comprehensive benefits such as flood control, power production and navigation, etc. In 1958, the Yangtze Valley Planning Office (YVPO) submmitted another report "The Essentials of the Preliminary Design of the Three Gorges Project", in which the Sandouping damsite and the scheme of 200m normal pool level(NPL) were recommended. Afterward, considerable efforts were made for the project, including the comparative study on different NPL alternatives and damsites. In 1983, based on a new situation, YVPO prepared "The Feasibility Study Report on the Three Gorges Project" with 150m NPL scheme. Later, the State Council approved the 150m NPL scheme but supplemented that the dam crest should be raised to 175m, and ordered to carry on preliminary design on this basis. In 1985, The Preliminary Design Report on the Three Gorges Project" was completed.

Because of the grandiosity of the project, there still exist different opinions on the Three Gorges developement and its NPL design. Therefore, it was decided to carry out a supplemental justification work, together with further comparisons to be made among the 150-180m NPL alternatives. Afer justificatin, an alternative of 175m NPL has already been recommended.

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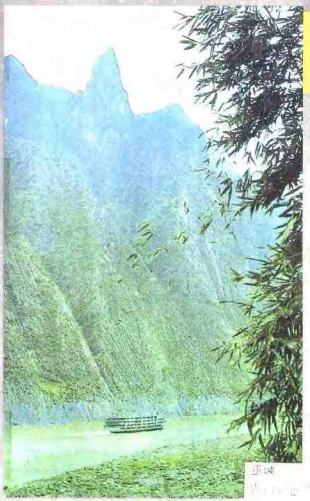
壮丽的三峡
The maiestic Three Gorges

瞿塘峡
Qutang Gorge



西陵峡
Xiling Gorge

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工程介紹

一九八六年至一九八八年，水利电力部三峡工程论证领导小组聘请了全国412位专家，组成了14个专家组，对三峡工程的各专题分别进行了论证，初步确定正常蓄水位为初期156米，后期175米，坝顶高程185米。并初步确定"一级开发、一次建成、分期蓄水、连续移民"方案。

三峡水利枢纽主要由拦河大坝、泄洪建筑物、水电站厂房、排沙孔及通航建筑物等组成。大坝为混凝土重力坝，坝线长约2000米（不含通航建筑物），最大坝高175米。泄洪坝段居河槽中部，设23个7×9米的泄洪深孔和22个净宽8米的表孔。两侧布置坝后式电站厂房，左厂房装机14台，右厂房装机12台。并设5个4×5.5米的排沙孔。水轮机转轮直径9.5米，水轮发电机组单机容量68万千瓦，总装机容量为1768万千瓦。通航建筑物布置于左岸。永久通航为双线5级连续梯级船闸，闸室有效尺寸为280×34×5米（长×宽×最小水深）。并设一线一级垂直升船机，承船厢有效尺寸为120×18×3.5米（长×宽×水深）。施工期间设一线一级临时船闸维持通航，闸室有效尺寸为240×24×4米，并利用升船机和导流明渠辅助施工期通航。

正常蓄水位175米方案，枢纽主要工程量为：土石方开挖约8000万立方米，土石方填筑约3200万立方米，混凝土浇筑2613万立方米，金属结构安装25.7万吨。

枢纽工程从施工准备开始到第一批机组发电为12年，到全部竣工为18年。总投资按一九八六年底不变价格估算为361.1亿元。即：枢纽工程投资187.67亿元，五十万伏送变电工程投资62.82亿元，水库淹没补偿费110.6亿元。迁移人口约72.55万，淹没耕地43.13万亩。

三峡工程坝址风光
The dam site of the Three Gorges Project

中堡岛
Zhongbaodao Island

Major Hydraulic Structures

From 1986 to 1988, the TGP Justification Leading Group of MWREP invited 412 specialists (in 14 panels) to study every subject of the project. Based on the study results, the Group has preliminarily developed the proposal of "Development ni one cascade, completion at one stroke, impoundment in stages and resettlement in succession", with an initial NPL 156 m, a late NPL 175 m and a crest El. 185 m.

The project is mainly composed of a dam, flood-discharging facilities, power houses, silt orifices and navigation structures. The concrete gravity dam has a crest length of 2000 m (excluding the navigation structures) and a maximum height of 175m.

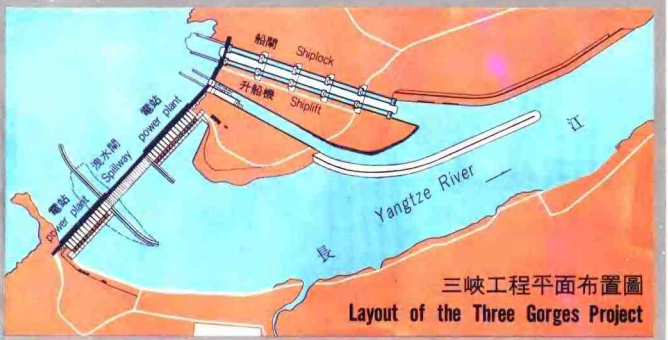
奇峰秀岭——剪刀峡
Scissors Gorge, with its beautiful peaks.

Located in the middle of the channel, the spillway is furnished with 23 deep outlets (7x9 m) and 22 surface orificies(8 m in net width). On each side of the spillway, there stands a power house at the dam toe, with 14 generating units in the left house and 12 in the right one. And 5 silt orifices(4x5.5m) are set for the purpose of silt-sluicing. Each of the generating units shares 680 Mw of the total installed capacity of 17,680 Mw. And the runners are 9.5 m in diameter.

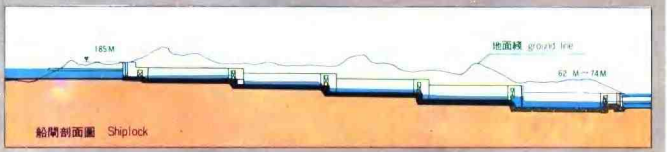
The permanent navigation facilities are located on the left bank, consisting of a five-stage double lane shiplock with an effective dimension of 280 x34 x 5 m(length x width xdraft) and a one-way shiplift with an effective dimension of 120x18x 3.5m. For the sake of navigation during construction, a temporary one-way shiplock is provided with an effective dimension of 240 x 24 x 4 m. Besides, the shiplift and diversion channel are also used for navigation during construction.

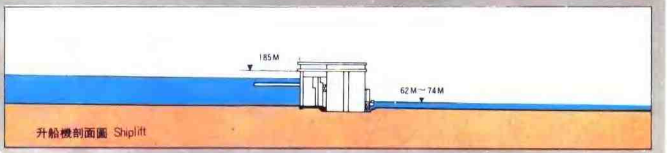
Depending on the proposed scheme (NPL 175 m), the main works are as follows: soil and rock excavation 80,000,000m³, embankment 32,000,000 m³, concrete 26,130,000 m³ and metal structures 257,000t.

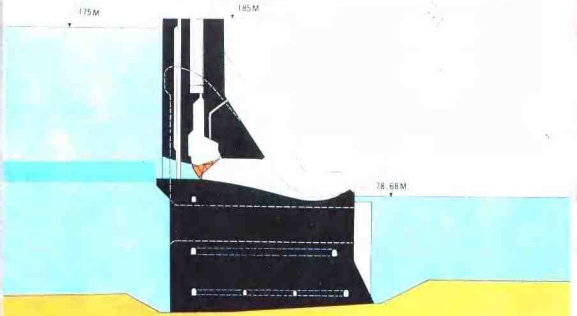
It will take 12 years to put the first units into commission. And the total construction period will be 18 years. Based on the fixed prices in 1986, the total construction cost will be 36.11 billion RMB yuan (i.e. 18.767 billion yuan for project investment. Total cost of 500 kv power transmission project is 6.282 billion yuan, and 11.06 billion yuan for inundation compensation). For the construction of the project, 725,500 persons will be relocated and 431,30 0 ha farmland inundated.



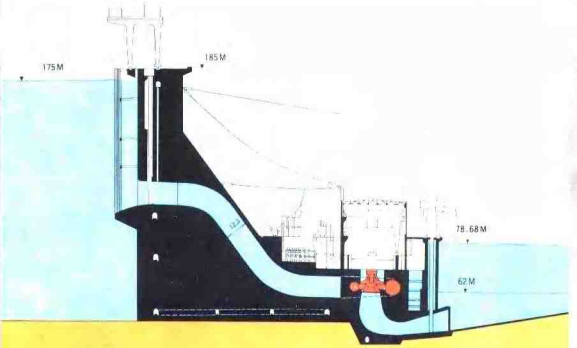
三峽工程平面布置圖
Layout of the Three Gorges Project







溢流壩段剖面圖 **Spillway**



廠房壩段剖面圖 **Power house**

防洪

长江中下游平原是中国工农业精华地区，但地面高程普遍低于洪水位，主要靠总长约3万公里的堤防防护，因此洪水灾害频繁、严重。据历史记载，自公元前185年至公元1911年共发生200多次，平均约10年一次。十九世纪发生过1860、1870两次特大洪水，宜昌洪峰流量达92,500及105,000秒立方米，灾情极为严重。本世纪1931、1935、1954年也发生过严重洪水灾害。建国后，大力培修加固堤防，已累计完成土方30余亿立方米，石方6,500余万立方米，但堤防仍只可防御约10～20年一遇洪水。超过这一标准，即需使用分洪区。长江中下游防洪问题又以荆江洞段（枝城至城陵矶）最为突出。北岸荆江大堤，平均高12米，最高达16米，全长180余公里，保护约18,000平方公里的平原地区。区内约有1,200万亩耕地，700余万人，地面一般低于长江洪水位几米至十几米。万一大堤溃决，不仅经济损失严重，而且还将造成大量人口死亡的毁灭性灾害，并威胁武汉市的安全。目前荆江大堤约可防御10年一遇的洪水。配合荆江分洪工程等分洪区的运用，约可防御20～50年一遇的洪水。但分洪区人口也很稠密，例如荆江分洪区内目前即有40多万人，分洪付出的代价也很大。且当上游洪峰超过80,000秒立方米时，还无防止毁灭性灾害的切实可靠措施。防止特大洪水造成荆江地区毁灭性灾害仍然是当前长江防洪中最严重的一个问题。三峡工程地理位置优越，能最有效地控制上游进入中下游平原的洪水。正常蓄水位175米，水库共有防洪库容221.5亿立方米，遇百年一遇洪水，可在不运用荆江分洪区的情况下控制荆江河段的流量在安全范围以内（枝城站流量不超过56,700～60,000秒立方米），遇千年洪水或1870年洪水，可控制枝城站流量不超过80,000秒立方米，配合分洪也可控制荆江河段的流量在安全范围以内。因此三峡工程是长江中下游防洪体系中的重要一环，而且对解决荆江地区毁灭性洪灾来说更是难以替代的。

发电

我国能源分布的总情况是：南方水能资源多，北方煤炭资源多，而水能资源的分布则是西部多，东部少。三峡水电站正处于我国能源分布"南水北煤"和电网布局中"西电东送"的联接地带。正常蓄水位175米方案，装机容量1,768万千瓦，年平均发电量840亿度，可节煤约4,000万吨。主要供电华中、华东，近期还兼顾川东。对扭转华中、华东地区缺电和减轻北煤南运的负担具有战略意义。

航运

长江是中国东西水运交通的大动脉。重庆至宜昌河段，全长660公里，通常所说川江即指这一河段，是联系西南和华中、华东地区的重要交通纽带。但急弯多，航道窄，滩多流急，航行条件较差。因此改善川江航道条件，对西南地区经济发展有重要意义。正常蓄水位175米方案，重庆以下河段的急流滩险大部或全部在回水淹没范围之内，库区将形成570～700公里的深水航道，航行条件将比建库前有显著的改善。同时，经过水库调节，枢纽下游的枯水流量可以从3,000秒立方米左右提高到约5,500秒立方米，将使宜昌以下河段（特别是荆江河段）的航道条件也得到改善。因此三峡水利枢纽的兴建将十分有利于长江航运事业的发展。

其他

三峡水利枢纽的兴建，还将为水库水产养殖，发展旅游事业等方面创造有利的条件。

长 江
宜昌—武汉防洪形势示意图
SCHEMATIC FEATURES OF FLOOD CONTROL FOR YICHANG— WUHAN ON THE YANGTZE

荆江大堤
Jingjiang Levee

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Project Benefits

Flood Control

The plains in the middle and lower reaches of the Yangtze,a place where our industry and agriculture are most flourishing, are incessantly menaced by flood hazards owing to the ground surface being invariably lower than the flood water level,relying chiefly on 30,000 km long levees for their safety. According to historical records, there occurred in the area,from 185 B.C.to A.D.1911,a total of more than 200 floodings, about once every ten years, In the 19th century there were two extraordinary floods, one in 1860 and another in 1870, producing peak flows at Yichang of up to 92,500 and 105,000 cu m per second respectively. In both cases the damages were extremely heavy. In this century the 1931,1935 and 1954 floods also caused heavy losses. Since liberation, many efforts have been devoted to repairing and strengthening the levees,with the earth and rock-work done to the accumulative amount of 3 and 0,065 billion plus cu m, nevertheless they could withstand only a 10-to-20-year-frequency flood;in case the flood goes beyond such a standard, flood diversion regions would have to be operated. In short, of all flood control problems for the middle and lower reaches of the Yangtze, the most critical is that of the jingjiang stretch(from Zhicheng to Chenglingji) On its north bank, there is a high levee called the jingjiang Levee, about 180 km long,with an average height of 12m and a maximum of 16m. The levee protects about 18,000 sq km of the plain area, including some 12 million farmland and 7 million plus residents. The ground surface being usually several to ten plus m lower than the flood water level in the river.Should the jingjiang Levee be overtopped, there would be not only heavy economic losses but also catastrophic hazards of heavy casuaties, and the safety of Wuhan City would also be threatened. At present the jingjiang Levee is capable of withstanding a flood of about 10-year frequency, or of 20-to-50-year frequency with the operation of the existing flood diversion projects But the lands to where the excess floodwater will be directed are rather densely populated (for instance the population of the jingjiang flood diversion area is more than 400,000). Consequently, their operation will be rather costly. Farthermore, no adequate measures could be available to prevent the occurance of the above mentioned catastrophic hazards in case the peak flow upstream of jingjiang were more than 80,000 cu m per second. This is a most acute problem to be encountered in the flood control of the Yangtze River today. Geographically well-siluated, the Three Gorges project can most effectively control the incoming floods that would otherwise run down directly toward the plains in the middle and lower reaches.

For the 175 m NPL schemethe reservoir has a flood storage of 22,15 billion cu m, In case of a 100-year flood, the flows of the jingjiang section can be kept within the safety limits(not exceeding 56,700-60,000 cu m per second at Zhicheng) without the operation of the Jingjiang Flood Diversion Project. In case of a 1,000-year or the 1870 flood, the project will be able to control the discharge at Zhicheng to be not more than 80,000 cu m per second, and, with the coordinated operation of the established flood diversion projects, it will be able to keep the discharge in the Jingjiang stretch within its safety range. Therefore, the Three Gorges project is not only an important constituent in the flood control system of the middle and lower reaches of the Yangtze but is also not replaceable in the role of preventing the devastating floods in the Jingjiang region

Power Generation

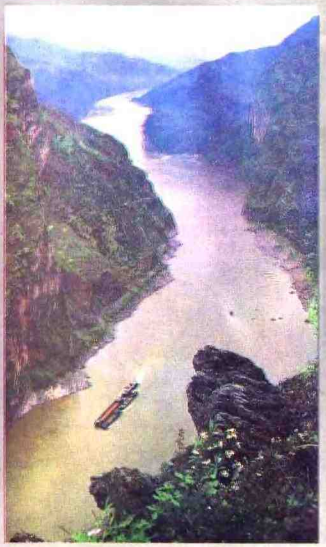
The general distribution of the country's energy resources is that southern China is rich in hydro potentials while northern China in coal reserves, and that the hydro potentials are distributed more in the west than in the east. The Three Gorges project is just located at the hub of the southern hydro and the northern coal in resource distribution, and at the junction of the western electric power transmitted to the eastern load centers. With the NPL at 175 m,the project will be able to produce an annual energy of 84 billion kwh with installed capacities of 17680 MW,resulting in an annual saving of about 40 million tons of coal respectively. Its service area will cover mainly central China and east China, giving in the initial period certain consideration to east Sichuan. When constructed, the Three Gorges project will be of strategic significance in putting an end to the shortage of energy in central China and east China and mitigating the burden of transporting coal from the north to the south.

The Yangtze River is an artery of China's latitudinal water transportation. The 660 km stretch from Chongqing to Yichang, referred to generally as Chuanjiang or the Chuan River, is an important transportation tie linking the south-west, central and east China regions. But it is rather poor in navigation conditions due to numerous sharp bends, narrow channels, shoals and rapids.Hence the improvement of the navigation conditions in this stretch is of great significance in the economicic development of the southwestern region. With the NPL set at 175 m the existing rapids and dangerous shoals in this river stretch below Chongqing will be wholly or mostly within the backwater and the inundated zone, and deep navigable channel of some 570～700 km in length will be created in the reservoir area,resulting in significant improvement on the shipping conditions. Meanwhile, the low water flow below the project will be increased through reservoir regulation from around 3,000 cu m per second to about 6,000 cu m per second thereby improving the shipping conditions in the river reaches below Yichang,especially the jingjiang stretch. It is,for this reason,considered that the construction of the Three Gerges project will be very advantageous to the development of the Yangtze River navigation.

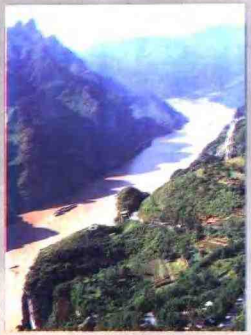
Other Benefits

The construction of the Three Gorges project will also create favourable conditions for the development of aquatic farming and recreational opportunities in the area.

仙人桥
Fairy Bridge



江水弯弯去 轻舟曲曲来。
the winding river, the trailing sails.



壩址下游峽谷風光
A scenic of the gorge below the dam site.

葛洲坝水利枢纽，位于三峡出口南津关下游2.3公里处，是三峡水利枢纽下游的一座反调节枢纽和航运梯级。

该工程由长江流域规划办公室设计，在有关部门的共同协作下，解决了在长江这样的大河上、泥沙和地质条件十分复杂的情况下修建巨型工程的一系列关键问题，1986年荣获国家科技进步特等奖。葛洲坝工程的兴建，不仅为了获得发电、航运等综合效益，而且也为建设三峡工程作实战准备。

葛洲坝水利枢纽沿坝轴线的总长为2606.5米，自左至右为（1）三江航道，设有两座船闸；三号船闸闸室有效尺寸18米×120米×3.5米，二号船闸为34米×280米×5米，水级都为27米；一座冲沙闸，最大泄水能力为10,000秒立方米；（2）二江水电站，装机容量96.5万千瓦，其中2台水轮发电机组的水轮机为4叶片轴流转桨式，直径11.3米，单机出力17万千瓦。其余单机出力为12.5万千瓦；（3）二江泄水闸，最大泄洪能力83.900秒立方米；（4）大江水电站，装机容量175万千瓦两座水电站的年平均发电量157亿度；（5）大江航道，设1号船闸，规模与2号船闸相同；一座泄洪冲沙闸，最大泄水能力25,000秒立方米。

该工程于1981年元月4日截流，当年开始发挥效益。整个工程于1988年底全面竣工。共开挖土石方约8,900万立方米，浇筑混凝土约1,042万立方米，安装金属结构约7.5万吨。

The Gezhouba project is located at the lower entrance of the Three Gorges, down stream from Nanjin Pass 2.3 km It serves the function of a reregulator and also a navigation flight for the Three Gorges project.

With the cooperation of other departments concerned, the project was designed by the Yangtze Valley Planning Office. During the course of design and construction of the huge project,a series of technical problems of crucial tance, such as those closely related to the greatness of the Yangtze and those associated with sedimentation and very complicated site geological conditions, have been fruitfully solved. For its significant contributions to the socialist construction,a National Science and Technology Achievement Award of Special class was rewarded in 1986. The building of Gezhouba is not only with the aim of gaining the immediate benefits from electricity generation and navigation improvement but also a rehearsal for the construction of the proposed Three Gorges project.

长江葛洲坝水利枢纽

The Gezhouba project

大江截流
Closure of grand channel at Gezhouba

The crest of the Gezhouba dam is 2606.5 m long. The layout,from left to right, is as follows:

1. The third—channel navigation facilities,including two locks and one sluice;

Lock No. 3,effective chamber dimension-18×120×3.5m, with a drop of 27m;

Lock No. 2,effective chamber dimension-34×280×5m; with a drop of 27m;

Sluice;max.discharging capacity-10,000 cu m per second.

2. The second-channel hydropower plant,

Total installed capacity: 965 MW;

For two of the seven units installed:

Type of turbine, axial flow with four movable blades;

Diameter of runner, 11.3m on the centerline of setting;

Unit output 170 MW

3. The second—channel spillway

Max discharging capacity 83,900 cu m per second.

4. The grand—channel hydropower plant;

Total installed capacity:1,750 MW.

5.The grand-channel navigation facilities, including one lock and one sluice/spillway.

Lock No. 1;same as lock No.2;

Sluice/Spillway;max.Discharging capacity 25,000 cu m per second.

Total annual energy generated by the two hydropower plants is 15.7 billion kWh.

The river closure was successfully accomplished on Jan.4, 1981, and the project was put into service in the same year. The whole hydraulic structures of the project will be duly Completed at the end of 1988. The work quantities involved are listed below;

Excavation and fill: 89 million cu m;

Concrete,10.42 million cu m;

melta structures: 75,000 tons.