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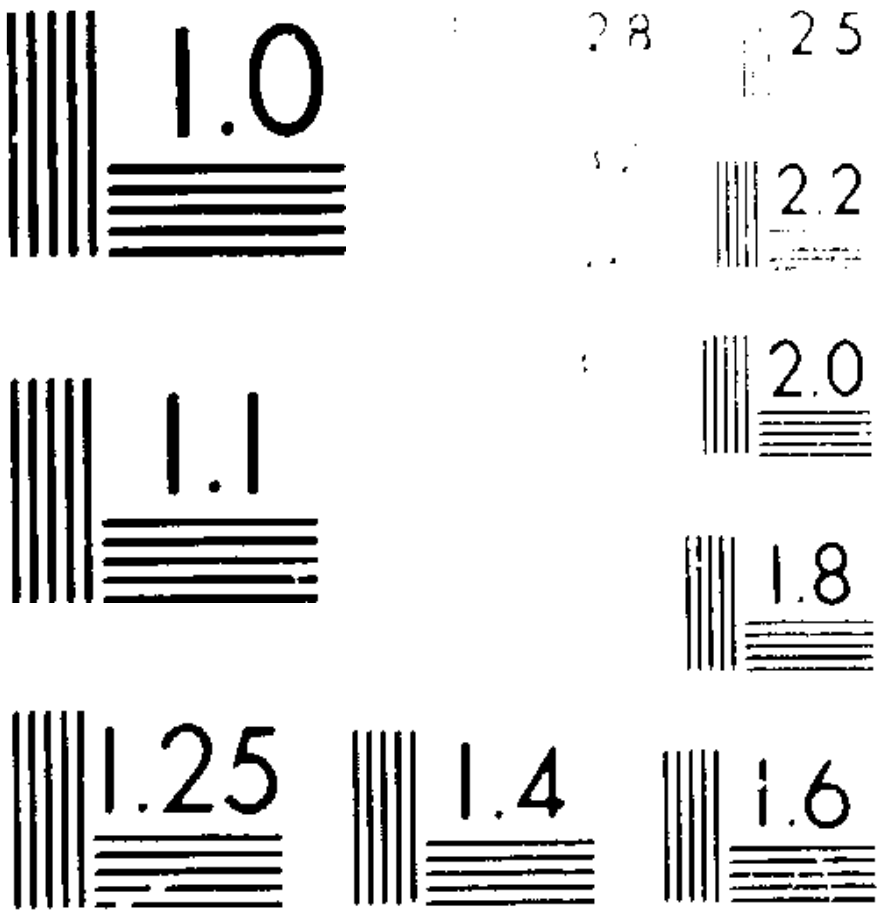
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# YEMEN ARAB REPUBLIC

## THE MANUFACTURE OF CONCRETE PIPES AND OTHER PRODUCTS

## AN OPPORTUNITY STUDY*

G. Appel

1982



WORLD BANK/UNIDO
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## PREFACE

The construction industry in the Yemen Arab Republic has been the subject of a series of reports compiled by the World Bank/UNIDO Co-operative Programme beginning in 1979 with a general survey of construction materials. Arising from recommendations in these reports, the present study for the manufacture of concrete pipes and other products was prepared at the request of the Ministries of Municipalities and Public Works. The World Bank/UNIDO Co-operative Programme sent a mission to the Yemen Arab Republic for two weeks in December 1980 to gather basic data for this report. The technical data were prepared in Austria in co-operation with Mr. Günther Appel, consultant engineer. The report was subsequently revised and edited in the offices of the World Bank/UNIDO Co-operative Programme.

## CURRENCY EQUIVALENTS

| | | |
|---|---|---|
| Currency Unit: | Yemeni Rial (YR) | |
| Currency Equivalent: 1/ | 1 YR = | 100 Fils |
| | 1 YR = | US$ 0.22 |
| | US$ 1 = | YR 4.5 |

## ABBREVIATIONS

| | |
|---|---|
| A-C | Asbestos Cement |
| ASTM | American Society of Testing Materials |
| CP | World Bank/UNIDO Co-operative Programme |
| DIN | German Industrial Standards (Deutsche Industrie-Norm) |
| FRR | Financial Rate of Return |
| ISO | International Standards Organization |
| LTL | Long-Term Loan |
| NWSA | National Water and Sewerage Authority |
| TPY | Tons (Metric) per Year |
| YAR | Yemen Arab Republic |
| YGEC | Yemen General Electricity Corporation |
| WB | World Bank |

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1/ Official rate of exchange since February 1973.

## SUMMARY

i. The construction industry was a major participant in the growth of the Yemen Arab Republic economy during the 1970's. Government revenues, together with migrant workers' remittances and external grants and loans, supported an expanding public works programme to establish the infrastructural facilities (including roads, water and sewerage services) and electricity supplies, which were previously lacking in the country. Public and private building construction activity expanded significantly. Budgeted government development expenditure nearly trebled, from YR 340 million in 1975/76 to YR 1,272 million in 1979/80. Although disbursements lagged behind planned expenditure, the construction industry had to rely to a large extent on imports in carrying out the programmes. Local cement output of only 50,000 tons a year has been supplemented by large-scale imports, which will only be relieved when the 500,000 tons per annum cement works, now under construction at Amran, starts production in late 1982. Many other building materials continue to be imported.

ii. These deficiencies were recognized in the Construction Materials Subsector Study prepared by the World Bank/UNIDO Co-operative Programme (CP) during 1979-1980, the recommendations of which included the setting up of a concrete pipe plant. A subsequent survey of the YAR construction industry, also commissioned by the CP in 1980, confirmed the need for a wider range of reliable concrete products. The Ministry of Municipalities of the YAR expressed interest on several occasions in the possibility of erecting a concrete pipe plant to supply pipes for sewerage systems, thereby reducing the import of expensive asbestos-cement pipes. The Ministry was also interested in other concrete products which, although not now used in the country, will be required in future. The Ministry of Public Works, the National Water and Sewerage Authority and the Yemen General Electricity Corporation expressed their support for such a project, prompted mainly by their need for concrete construction materials to carry out the current and future Five Year Plan Programmes. The World Bank is currently studying a credit line for the expansion and modernization of local stone quarrying and cutting operations. The proposed concrete products plant could possibly qualify as a further component of the credit line.

Several privately-owned quarries and ready-mix concrete plants are also interested in the local manufacture of concrete products, and have land, quarries, water wells, power plants, crushers and graders, and even large capacity concrete mixers which could be employed by the project.

iii. The mission surveying the YAR market in November-December 1980 established that increasing quantities of plain and reinforced concrete pipes are needed for urban sewerage and storm drain systems. Concrete poles and cable blocks for electricity and telephone lines and for street illumination could be introduced to replace less efficient and, in the long run, more costly alternatives such as wooden and steel poles. Prefabricated concrete slabs, kerbs and channels could secure a small but growing market. Some of these products, for instance large diameter and reinforced pipes, poles and cable blocks, have not yet been designed or used in the country's construction projects as they are not obtainable locally and are difficult to import. Large amounts of small diameter asbestos-cement pipe have been imported, i.e. about 100,000 metres a year costing between YR 10 to 15 million. Much of this could be replaced by machine-moulded concrete pipes of 200 to 500 mm diameter from the proposed factory.

iv. Resulting from plans for construction schemes, supported by financial and population projections, this report proposes the installation of a plant to manufacture:

| | | Tons per Year |
|---|---|---|
| (a) | Non-reinforced pipe, 200 to 500 mm diameter, including accessories; 30,000 metres per year | 4,800 |
| (b) | Large reinforced pipe, 600 to 2,500 mm; 12,000 metres a year | 28,800 |
| (c) | Poles, reinforced concrete; 7,000 units | 7,200 |
| (d) | Cable blocks; 24,000 units | 4,800 |
| (e) | Pre-fabricated pieces such as sidewalk slabs, kerbs, channels | 14,400 |
| | Total | 60,000 |

This production programme would be subject to a more definitive and up-to-date market survey before detailed planning of the project. It might then be feasible to introduce new product lines such as

pre-stressed beams for buildings and bridges, fencing posts, etc., which would make the project less dependent on securing a market for the large amount of reinforced pipe included in the programme.

v. A mechanized plant is proposed for the manufacture of products to close specification and of consistent quality. The preferred location is Sana'a, which is the main centre of construction activity. Good quality sand and aggregates are available at several sites, and a large cement works is now under construction at nearby Amran. The estimated cost of the factory, based on quotations from ten equipment suppliers, is YR 3' 9 million (US$ 7.8 million equivalent), of which the installed cost of the machinery and equipment is YR 26.4 million. The fixed assets, preliminary expenses and working capital total YR 40.5 million (US$ 9.0 million equivalent) at 1981 estimated prices. As a government supplier, the project is expected to receive exemption from taxes and duties on imports for the first five years (Law No. 12 of 1970).

vi. The main raw materials, cement, sand and aggregates, are available locally, but reinforcing steel would have to be imported. Annual operating costs before depreciation and interest amount to YR 21 million in years 4 and 5, and rise to YR 21.6 million a year when imports bear 10 per cent duty from year 6 onwards. The sales prices of the concrete products average YR 542 (US$ 120.50 equivalent) per ton, with an annual sales value at full production of YR 32.5 million.

vii. The internal financial rate of return of the project at constant input and sales prices is 18.8 per cent over the first fifteen years of operation. The pay back period for the total capital expenditure is just over five years. The economic rate of return is expected to be correspondingly high as the cost of importing these bulky products or substitute construction materials, would appear to be higher than the local cost of production. Without them, the construction of road, sewerage, electricity and other infrastructure schemes could be severely constrained.

viii. Reflecting the interest shown during the survey by government departments and institutions in a modern concrete products facility,

the study envisages that several investors are likely to come forward to collaborate in an investment agreement leading to the formation of a company to implement the project. The proposed financing plan requires YR 16.2 million of equity share capital and YR 24.3 million (US$ 5.4 million equivalent) in long-term loans and suppliers credits. The debt is assumed to bear interest at 10 per cent per annum and to be repayable over eight years after a two year grace period.

ix. The estimated return on shareholders' equity, assuming a 60:40 debt:equity ratio, varies between 11% in year 2 and 43% in years 11 to 15.

x. The direct foreign exchange expenditure to erect the plant during a one year construction period is estimated at US$ 6.5 million, which would be largely covered by the US$ 5.4 million equivalent loan in foreign currency, supplemented by foreign participation in the share capital or by foreign exchange from government sources. As many of these products are not yet used in the YAR, it is not possible to quantify precisely the foreign exchange savings which should accrue when the plant is in production.

## I. PROJECT CONCEPT

1. The project is designed to manufacture high quality concrete products called for by the growing capital expenditure programmes of government departments and the private sector. The products include:

(1) Non-reinforced concrete sewerage pipes to partly replace imported asbestos-cement pipes;

(2) Reinforced, large diameter concrete pipes for sewerage and storm water;

(3) Electricity poles;

(4) Cable blocks;

(5) Slabs, kerbs, etc.

2. The existing concrete industry in the YAR is not equipped to produce a range of products of suitable specification and quality for use in government sewerage, road, electricity and other construction projects. Planned development expenditure in the YAR nearly trebled from YR 340 to YR 1,272 million between 1975/76 and 1979/80. The country became increasingly dependent on cement imports, while local production of cement was restricted to 50,000 tons a year from the existing works at Baijil. However, construction began in 1980 on a 500,000 tons per annum plant at Amran which is projected to start production at the end of 1982. The Amran plant is not far from Sana'a, where it is proposed to locate the concrete products project, which will require 8,750 tons of cement a year. Other raw materials such as sand, aggregates and water, as well as power are available in the Sana'a area.

3. Sales at nominal capacity of 60,000 tons of products per year will be YR 32.5 million. The estimated cost of factory construction in 1981-82 is YR 40.5 million (US$ 9.0 million equivalent), comprising fixed assets of YR. 34.9 million, preoperating expenses of YR 2.3 million and working capital of YR 3.3 million. The plant will include five separate production lines served by raw materials and concrete preparation units, and equipment for handling finished products. Employment on a single shift will be 51 including expatriate personnel. Provision is made for additional expertise and training in the early years.

4. The proposed financing plan requires YR 16.2 million (US$ 3.6 million equivalent) of share capital, in which it is expected that government institutions will be the principal investors. Long-term loans of YR 24.3 million (US$ 5.4 equivalent), constituting sixty per cent of total investment, should be available from equipment suppliers and international financial institutions.

## II. THE MARKET

### A. Concrete Pipe

#### Main Uses

5. The use of concrete pipes in the YAR has been very limited. Production is in the hands of artisan-type entrepreneurs unable to furnish the quality and quantities expected of an industrial operation. These pipes, which are generally of small diameter, are used for sewerage systems.

6. The National Water and Sewerage Authority (NWSA) and the municipalities of the main cities (Sana'a, Hodeidah, Taiz, Ibb, Damar) are currently building or planning to build public sewerage systems which will entail the use of considerable amounts of pipe.[1/] These systems were originally planned to be implemented in two stages: the first in the downtown sections of the cities, expected to be completed by 1983; the second in zones adjacent to those sections to cover urban expansion, to be finished by 1990.

7. Although considerable delays have and will be encountered in the implementation of the first stage, asbestos-cement (A-C) pipe has either already been imported or contracts have been awarded to construction firms to supply the necessary amounts of imported A-C pipes. The second stage of the sewerage and drainage programme constitutes the main potential market for concrete pipes, provided they are able to compete in quality and price with A-C pipes, as contemplated in this study.

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1/ Water lines are not considered because NWSA uses "ductile iron" for this purpose, in accordance with general practice in most countries.

8. There are other potential uses for concrete pipes. Although rainfall is quite moderate in the country, cities like Sana'a and Taiz require separate drainage systems so as to prevent floods in certain urban sections. Construction of new roads and upgrading of existing ones will require culverts. Irrigation programmes may include the use of pipes instead of open channels and ditches so as to avoid evaporation loss. Because pipes have not been put to such uses before in the YAR, it is difficult to estimate the volume that may be required. For this reason, market projections are based on demand for sewerage. Any other uses would represent additions to the market projections.

## Methodology

9. In order to estimate the demand for pipes for sewerage systems, it is assumed that the various programmes included in the first stage (under construction or with awarded contracts) are indicative of the amounts and types of pipe that will be used in the second stage and thereafter, which is geared to meeting the needs resulting from increases in population in the main urban areas. The methodology used therefore includes a per capita index of pipe utilization based on the extension of sewerage systems included in the first stage and on population figures at the completion of this stage (1983). The same index is applied to the incremental urban population for the years 1984 and beyond.

## Projections

10. The last population census in the YAR took place in 1975. Based on the census results, the Berger-Kampsex team 1/ prepared projections of urban population for 1976, 1981, 1986 and 2000. Figures for other years are calculated according to growth rates for each period and each city. These results are indicated in the table overleaf:

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1/ "Proposal for Development Plans for Sana'a, Ta'izz and Ibb, also Hodeida" prepared by Louis Berger International Inc. and Kampsex International A/S.

GROWTH OF URBAN POPULATION

('000)

| YEAR | SANA'A | TAIZ | HODEIDAH | DAMAR | IBB AND NEIGHBOURS | OTHERS | TOTAL |
|---|---|---|---|---|---|---|---|
| 1975 | 135 | 79 | 80 | 19 | 103 | 30 | 446 |
| 1976 | 200 | 95 | 98 | 29 | 139 | 39 | 600 |
| 1980 | 313 | 130 | 152 | 45 | 204 | 44 | 888 |
| 1981 | 350 | 140 | 170 | 50 | 225 | 45 | 980 |
| 1982 | 376 | 147 | 186 | 55 | 245 | 54 | 1,063 |
| 1983 | 404 | 155 | 205 | 60 | 266 | 64 | 1,154 |
| 1984 | 434 | 163 | 224 | 66 | 289 | 77 | 1,253 |
| 1985 | 466 | 171 | 246 | 72 | 314 | 91 | 1,360 |
| 1986 | 500 | 180 | 270 | 79 | 341 | 109 | 1,479 |
| 1987 | 525 | 192 | 285 | 85 | 362 | 120 | 1,569 |
| 1988 | 552 | 204 | 300 | 91 | 384 | 132 | 1,663 |
| 1989 | 580 | 217 | 317 | 98 | 408 | 146 | 1,766 |
| 1990 | 610 | 231 | 334 | 105 | 434 | 160 | 1,874 |
| 2000 | 1,000 | 430 | 570 | 215 | 790 | 420 | 3,425 |

Source: Berger-Kampsex Report (underlined figures are taken from the report, the others are calculated by interpolation)

11. According to information obtained from the NWSA, the extension of the sewerage systems in the five main cities in the first stage is approximately 691 kms. If total population in the same cities reaches 1,090,000 inhabitants by 1983, average per capita use of pipe would be 0.63 metres, as indicated in the following table:

EXTENSION OF SEWERAGE SYSTEMS IN MAIN CITIES (FIRST STAGE)

| CITY | EXTENSION (m) | POPULATION IN 1983 | PER CAPITA (m) |
|---|---|---|---|
| Hodeidah | 200,000 | 205,000 | 0.98 |
| Damar | 67,000 | 60,000 | 1.12 |
| Ibb | 61,100 | 266,000 | 0.23 |
| Taiz | 163,050 | 155,000 | 1.05 |
| Sana'a | 200,000 | 404,000 | 0.50 |
| TOTAL | 691,150 | 1,090,000 | 0.63 |

Source: NWSA, Berger-Kampsex Report and Mission estimates.

Applying the per capita index of 0.63 m to the incremental population for the years following 1983, it is possible to obtain projections for additional lengths of pipe required in order to maintain the same standard as in 1983. The results are shown below:

PROJECTIONS OF DEMAND FOR SEWERAGE PIPES

| YEAR | TOTAL URBAN POPULATION ('000) | INCREMENTAL POPULATION ('000) | ADDITIONAL LENGTHS OF PIPE (KMS) |
|---|---|---|---|
| 1983 | 1,154 | - | - |
| 1984 | 1,253 | 99 | 62.4 |
| 1985 | 1,360 | 107 | 67.4 |
| 1986 | 1,479 | 119 | 75.0 |
| 1987 | 1,569 | 90 | 56.7 |
| 1988 | 1,663 | 94 | 59.2 |
| 1989 | 1,766 | 103 | 64.9 |
| 1990 | 1,874 | 108 | 68.0 |
| 2000 | 3,425 | 204 | 128.5 |

Source: Berger-Kampsex Report and Mission estimates.

Diameter of Pipe

12. Most pipe used in the YAR is of small diameter. i.e. between 100 and 600 mm. As already mentioned, such pipes are used mainly for internal sewerage networks in buildings and for connections to the main public sewerage lines. The main sewers can be visualized as a telescopic system whereby the diameter of the various sections increases in proportion to the total flow of sewage, which in turn is proportional to the number of inhabitants in the area served. Thus, the sections with the largest diameters are located at the end of the system, delivering wastes to the disposal and treatment installations. For practical reasons, sewerage pipes having diameters greater than 2,500 to 3,000 mm are build in situ with reinforced concrete and have an egg-shaped cross-section to ensure self-cleaning.

13. It is estimated that no more than 10 per cent of the present total demand for sewerage pipes is in the range of 600 to 2,500 mm

diameter, while 90 per cent is in the range of 100 to 600 mm diameter. In both cases, the major concentration is in the smaller diameters. However, the proportion of pipes having large diameters is expected to increase in the future when more of the population is served by sewers. The construction of drainage systems to handle rain water and avoid flooding requires pipes of large diameter, which will increase the proportion of pipes in the 600 to 2,500 mm range. PVC pipes appear to be preferred for diameters of between 100 to 200 mm, which represents an estimated 80 per cent of total demand. PVC pipe is produced locally in a plant located in Taiz. Concrete pipes with smaller diameters would therefore have to compete with PVC pipes, and their potential market may be very limited.

Recommended Plant Capacity

14. For diameters of between 600 and 2,500 mm, which have to be reinforced with iron wire or rods, the project under consideration could aim at the total potential market estimated to be around 10 per cent of the figures indicated in the projections. A maximum annual capacity of 12,000 m, based on one eight hour shift per day, is therefore recommended.

15. The market for pipes with diameters of between 100 and 600 mm and without reinforcement is considerably larger. Here again, however, these will have to compete against PVC pipes, and, to a lesser degree, against concrete pipes produced by artisan-type operations. It is recommended that the initial production capacity for this type of pipe be in the order of 30,000 m per year, based on one eight hour shift per day and representing around 30 per cent of the total potential market. If market penetration proves satisfactory, production may later be increased by adding a second shift, or by building a second plant in another suitable location. For the latter alternative, it must be borne in mind that transportation costs for the products will be very high. The capacities recommended above for reinforced and simple concrete pipe include the corresponding amounts of accessories such as bends, crossings, connections, manholes, etc., apart from the very large diameters (2,000 to 2,500 mm), which will be built in situ.

B. Concrete Poles

Main Uses

16. Concrete poles are used in many countries to support overhead electricity transmission lines and for street illumination. In the latter case, the poles are hollow, with one or more metal arms at the top on which electric lamps are installed. Concrete poles are not in use at present in the YAR. Instead, imported wooden poles of lengths between 8 and 11 m are used. Hollow iron poles are used for street lighting in the main cities. The cost of wooden poles is on the average YR 400 per pole, while those made of iron are considerably more expensive. Such poles are short-lived because of damage caused by decay and corrosion. Moreover, as a result of electric discharges produced by thunder bolts or short circuits, they can be hazardous to human life. Concrete poles do not have these disadvantages.

17. The introduction of a regulation by the Ministry of Municipalities and/or the municipalities themselves prescribing the use of concrete poles instead of wooden and metallic poles is all that would be needed to open the market for concrete products. The Yemen General Electricity Corporation (YGEC), the only user and installer of poles, would also have to issue such a regulation. The use of poles for aerial lines will diminish in proportion to the rate at which YGEC will lay transmission lines under the ground. However, this process may take from five to ten years and, in the meantime, the use of poles for street and road illumination would become more general.

Methodology

18. Two different approaches have been used:

i) A minimum of eight poles is necessary (one every 50 m) for an average neighbourhood block of 100 m x 100 m (1 ha), for either illumination or transmission lines and connections to houses. It is estimated 1/ that Hodeidah, for example, will have an urban area of 2,595 ha by the year 1983, when its population may reach 205,000 inhabitants. Based on these figures, per capita use of poles would be:

1/ Berger-Kampsex Report

$$\frac{8 \times 2{,}595 \text{ ha}}{205{,}000 \text{ inhabitants}} = 0.1013 \text{ poles per inhabitant}$$

ii) In 1979 YGEC used approximately 6,000 new wooden poles, and it is expected that this number will increase at a rate of 10 per cent per year until 1985 and at a rate of 5 per cent thereafter.

Projections

19. Two sets of projections have been obtained.

i) Figures for future demand can be obtained by applying the per capita index of 0.1013 poles per inhabitant to population increments after 1983, as in the case of concrete pipes. However, such a calculation does not include replacing wooden and iron poles already installed, which in any case this would add to the projected figures.

ii) Projections may be based on growth rates estimated by YGEC for the periods 1979 to 1985 and 1986 to 2000. The results are summarized below:

PROJECTIONS OF DEMAND FOR CONCRETE POLES (IN UNITS)

| YEAR | PER CAPITA INDEX METHOD | YGEC METHOD |
|---|---|---|
| 1979 | - | 6,000 |
| 1980 | - | 6,600 |
| 1981 | - | 7,260 |
| 1982 | - | 7,986 |
| 1983 | - | 8,784 |
| 1984 | 10.030 | 9,663 |
| 1985 | 10,840 | 10,629 |
| 1990 | 10,940 | 13,566 |
| 2000 | 20,670 | 22,096 |

Source: Mission and YGEC estimates.

Recommended Plant Capacity

20. Based on the above projections, a production line with a capacity of 7,000 concrete poles per year (one daily shift of eight hours) is recommended. As in the case of concrete pipes, if the market proves to be larger, the plant can either work another shift or a new plant in another location may be justified.

## C. Cable Blocks

21. Cable blocks are used to install underground electric transmission and telephone lines, which are thus protected against atmospheric agents as well as against physical damage. Cable blocks are a completely new product in the YAR and would have to be introduced slowly to replace the more widely used aerial lines. Since the electricity and telephone companies are public-owned, the switch to undergound installations could be initiated without difficulty by a regulation from the Ministry of Municipalities and the municipalities of the main cities.

22. Considering that a minimum of 400 m of cable blocks must be installed for an average block of 100 m x 100 m (1 ha), the market potential may be considerable. For a city such as Hodeidah, the per capita index for 1983 would be:

$$\frac{400 \text{ m/ha} \times 2{,}595 \text{ ha}}{205{,}000 \text{ inhabitants}} = 5.06 \text{ m per inhabitant}$$

In other words, for Hodeidah alone a minimum of 1.04 million metres of cable blocks would be needed if the entire city were to be served with underground lines.

23. However, the introduction of cable blocks might take several years and may ultimately be limited to only the most affluent and modern areas in each city. Under these circumstances, it is difficult to prepare meaningful market projections. A production line with a minimum economic size of 24,000 m per year (one eight-hour shift) is therefore recommended. As in the case of other concrete products, output may be increased by adding a second shift or by building a new plant in another location.

D. Other Concrete Products

24. The other products contemplated in this pre-feasibility study are kerbs, sidewalk slabs and other pre-fabricated pieces made from plain and reinforced concrete. Because such building materials are not yet in use in the YAR, there is no means to estimate their potential market accurately until they are adopted in road and other construction schemes.

25. As an initial step towards the development of a market for standardized pre-fabricated concrete products, it is recommended to install a line with an annual capacity of 14,400 tons. The production of concrete blocks, tiles and other concrete products of small size is at present undertaken by small firms as well as by at least one large company. There is, however, a market for standardized products of higher quality.

26. Present technology is to manufacture poles and floor beams with pre-stressed concrete, reducing the weight and increasing the mechanical strength of the pieces. This alternative, which requires more expensive machinery and equipment, has not been studied for the present project, but may deserve further investigation.

E. Distribution Systems

27. At present, imported A-C pipe is stored in NWSA premises in the cities in which construction programmes for sewerage are already under way. The pipes are transported by truck from the depots to the construction sites. Small firms producing concrete pipes sell their products at the factory gate and transportation is either provided by or paid for by customers.

28. It is expected that sales contracts for the products of the plant will be signed with NWSA, the municipalities and the construction firms. Transportation from the plant gate to the delivery point will be provided by the customers, either using their own vehicles or under sub-contracting agreements, as is practiced at present.

29. For distribution to private customers, the management will appoint dealers from among local building material traders in each city. Transportation costs and dealers' profit will be added to the sale price at the plant gate.

30. Sales would normally be made on a cash basis. However, public institutions usually need time to process and approve invoices. For this reason, the working capital requirements calculated for the project include funds to finance clients' purchases for an average of 60 days.

## F. Sales Prices

31. Since the contracts already awarded for the construction of sewers contain only global figures covering the cost of all A-C pipe to be used, it is difficult to obtain prices for different types and diameters.[1/] The following table was prepared using 1978 prices for imported pipes; 1980 prices were estimated by applying a 5 per cent yearly increase rate.

PRICES OF ASBESTOS-CEMENT PIPE

(YR/METRE)

| Diameter mm | 1978 Total Cost (Installed) | 1978 Pipe Only | 1980 Pipe Only |
|---|---|---|---|
| 200 | 311 | 93 | 103 |
| 250 | 326 | 98 | 108 |
| 300 | 366 | 110 | 121 |
| 350 | 406 | 122 | 134 |
| 400 | 572 | 172 | 189 |
| 500 | 649 | 195 | 215 |
| 600 | 789 | 236 | 260 |

Source: "Sewerage network construction costs for Ibb and Damar", prepared by ITALCONSULT (August, 1978).

1/ The tender documents in NWSA's files may contain more detailed information which the Mission did not have opportunity to study.

32. Prices for artisan products vary considerably. For 200 mm diameter pipes, prices range between YR 75 and YR 100 per metre. The price variation is greater for pipes of larger diameters.

33. An average selling price of YR 460 per ton for 200 to 500 mm diameter pipe has been used in this study. It can be noted from the following table that, when translated into YR per metre, the prices used are considerably lower than those presently paid for imported asbestos-cement pipe (see table on page 11). On the other hand, the prices used are generally higher than prices for similar products in Austria (see para. 35) because of the higher cost of raw materials in YAR. The number of metres per ton varies according to the diameter, the thickness of the concrete and the type of material (reinforced or not reinforced). As an illustration, the following prices have been estimated for small diameter non-reinforced pipes:

| Diameter mm | Kg/Metre | Price YR/Metre | Price YR/Ton |
|---|---|---|---|
| 200 | 58 | 32 | 550 |
| 250 | 79 | 40 | 510 |
| 300 | 115 | 53 | 460 |
| 350 | 140 | 59 | 420 |
| 400 | 195 | 78 | 400 |
| 500 | 270 | 108 | 400 |
| Average | 160 | 73.6 | 460 |

34. The machinery and equipment selected and the systems of quality control for raw materials and finished products contemplated for the project will ensure compliance with internationally accepted standards for concrete sewerage pipe. A definite price advantage will therefore be gained by replacing imported A-C with locally produced concrete. The advantage remains even when transportation and installation costs for concrete products are higher. In fact, the unit prices calculated for the project are conservative and may, if necessary, be increased.

35. To provide a basis for comparison, Annex 3 gives prices and

weights of concrete pipes and other products in Austria, summarized below:

CONCRETE PRODUCT PRICES IN AUSTRIA

| | YR/Ton [1] |
|---|---|
| Pipe, non-reinforced, 200 to 500 mm dia. | 300 - 210 |
| Pipe, reinforced, 600 to 2,500 mm dia. | 560 - 670 |
| Concrete poles, 10 m and 15 m long | 600 |
| Cable blocks, 90 kg | 630 |
| Slabs, kerbs, etc. | 205 - 270 |

Source: Günter Appel, engineering consultant.

[1] at March 1982 (Austrian Schillings 3.33 = YR 1.00)

## III. RAW MATERIALS AND OTHER INPUTS

### A. Raw Materials

36. The raw materials used for the manufacture of concrete products are:

- cement
- aggregates (sand and crushed stone)
- reinforcing steel
- water

In order to arrive at the necessary amounts of these materials, the concrete required by each of the five production lines is calculated at nominal capacity, with a 4 per cent allowance for material losses and finished scrap i.e. 96% saleable output, as follows:

(i) Concrete pipe with diameters ranging from 200 to 500 mm:

On average, one linear metre of pipe weighs 160 kg and contains 0.064 $m^3$ of concrete. Therefore, for production of 30,000 metres per year, the concrete needed will be:

$$0.064 \times 30{,}000 \div 0.96\% = 2{,}000\ m^3$$

(ii) Concrete pipe with diameters ranging from 600 to 2,500 mm:

The average volume of concrete per linear metre of pipe is 0.96 $m^3$, and the annual production is 12,000 metres. Concrete needed will be:

$$0.96 \times 12{,}000 \div 0.96\% = 12{,}000\ m^3$$

(iii) Concrete poles:

The average volume of concrete is 0.41 $m^3$ per unit, and annual production is 7,000 units. The amount of concrete needed will be:

$$0.41 \times 7{,}000 \div 0.96\% = 3{,}000\ m^3$$

(iv) Cable blocks:

The average volume of concrete per linear metre is 0.08 $m^3$, and annual production is 24,000 metres. The amount of concrete needed will be:

$$0.08 \times 24{,}000 \div 0.96\% = 2{,}000\ m^3$$

(v) Pre-fabricated concrete flat forms (especially slabs and kerbs):

The average specific gravity is 2.5 tons/$m^3$. Annual production is 14,400 tons. The amount of concrete needed will be:

$$(14{,}400 \div 2.5) \div 0.96\% = 6{,}000\ m^3$$

37. The total amount of concrete needed to operate the five production lines at full capacity is thus:

| | | |
|---|---|---|
| Small diameter pipe (Pipe 1) | 2,000 $m^3$ | 8% |
| Large diameter pipe (Pipe 2) | 12,000 $m^3$ | 48% |
| Poles | 3,000 $m^3$ | 12% |
| Cable blocks | 2,000 $m^3$ | 8% |
| Flat forms | 6,000 $m^3$ | 24% |
| | 25,000 $m^3$ | 100% |

a. Cement

38. On average, 350 kg of cement per cubic metre of concrete are needed. The total amount of cement per year required would therefore be:

$$25{,}000\ m^3 \times 0.35 \text{ tons} = 8{,}750 \text{ tons per year (at 100 per cent capacity)}$$

Depending on the location of the plant, cement could be obtained from the Amran Cement Company, at present under construction 48 km north of Sana'a [1/]

1/ The contract was awarded to the Japanese firm IHI, which broke ground in September 1980. Production will start in late 1982. Plant capacity is 500,000 tpy, which may be increased later to 1 million tpy.

or from the Baijil Cement Company about 50 km east of Hodeidah 1/. Good quality cement (Portland Type I according to ASTM, or equivalent) will be available from either plant from late 1982 onwards.

39. At present, imported or domestically produced cement is sold in 50 kg multiwall paper bags at an official price of YR 34 per bag delivered at the construction site. Bulk cement may be available later, presumably at a lower cost, if the customer is equipped with adequate storage facilities (portable silos). The second alternative is included in this project.

b. Aggregates

40. On average, 1.3 $m^3$ of aggregates are used to produce one cubic metre of concrete. The yearly requirement for aggregates would therefore be:

25,000 x 1.3 $m^3$ = 52,500 $m^3$ per year (at 100 per cent capacity)

The main aggregates are sand and crushed stone, both of which are available in ample quantities. However, because of the high mechanical strength requirements of concrete pipes and other products, the aggregates must meet high quality standards regarding purity, hardness and petrographic composition. Moreover, granulometric grading must be performed carefully to allow for an exact formulation of the various types of concrete.

41. Quarrying operations and crushing and grading plants that were visited in Sana'a appear to have the equipment and the capacity to supply various grades of crushed stone from 5 to 20 mm. Regarding the supply of crushed stone, no major problems are foreseen for the concrete products plant.

42. The sand available in the YAR is mixed with soil and other

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1/ The Bajil plant has a capacity of 50,000 TPY and is being expanded to 300,000 TPY.

impurities. This explains, at least partly, the inferior quality of concrete products manufactured by small entrepreneurs. For this reason, sand washing and water recirculating equipment have been included in the proposed project.

43. Both sand and crushed stone are delivered at the construction site at a price of YR 100 per cubic metre. Transportation equipment for aggregates is not deemed necessary.

c. Reinforcing Steel

44. Reinforced concrete pipes and poles will contain an average of 97 kg of steel in rods or wire per cubic metre of concrete. Part of the slab and kerb production will be from reinforced concrete, requiring an estimated 50 tons of rod or wire:

| | |
|---|---|
| Larger pipes and poles (0.97 x 15,000) | = 1,450 tpy |
| Slabs and kerbs | 50 tpy |
| Total reinforcing steel | 1,500 tpy |

Steel wire and rods are not produced in the YAR and must be imported. A minimum stock of three months must be maintained. Minimum orders should be for a six month supply, for which the proposed plant will have sufficient storage facilities.

45. At present, reinforcing steel is delivered at the plant site at a price of YR 2,700 per ton.

d. Water

46. Water supply presents problems in the YAR. Water is usually obtained from wells 200 to 300 m deep. The water table in Sana'a is sinking at a rate of more than one metre per year, and presently available supplies represent about 12,000 $m^3$ per day. There is a single tariff for consumers of YR 5 per $m^3$, but according to NWSA, tariff rates will be reviewed soon. Medium and large scale industries normally drill their own water wells, for which NWSA authorization is needed.

47. The amount of water in the concrete mix is purposely kept low in order to ensure a high standard of strength in the resulting products. Water is used later in the process, during the "curing" or setting stage during which products are sprayed with water to ensure homogeneous hardening. In addition, water is needed for the sand washing plant as well as for cleaning and for sanitary facilities. It is estimated that total water consumption for all these purposes will be in the order of 300 $m^3$ per day.

48. Wherever its location, it is preferable that the concrete products plant be supplied by its own well. Drilling to 200 to 300 m is costly, and water must be pumped and stored in an elevated concrete tank, the full level of which is maintained automatically. From here, water flows by gravity to the various sections of the plant. The cost for these installations is estimated at YR 900,000 (US$ 200,000 equivalent) which, over 10 years, would result in an annual depreciation of YR 1.0 for $m^3$ of water. Adding operating costs would bring the price of water from YR 2.5 3.0 per $m^3$, which is less than the current NWSA rate. These expenses are included in the project operating costs.

B. Other Inputs

a. Electricity

49. The country's electricity supply will be considerably expanded in 1982, with the completion of both the new 150 MW thermal plant in Hodeidah and the national distribution grid. By that time, independent of the ultimate location of the concrete products plant, YGEC will be able to deliver all the power needed from a nearby 11,000 volts transmission line. Connection costs to the transformer inside the plant would be shared equally with YGEC.

50. On average, approximately 31 kWh per ton of concrete products will be used. YGEC has a single kWh rate of YR 1 per kWh for all users, but it plans to review this tariff in the near future.

b. Tar Rope

51. A gasket made of rope impregnated with tar is attached around the connecting end of each pipe as it is installed. A layer of cement then seals the connection.

52. Tar rope must be imported. As in the case of steel, a minimum stock of three months' supply should be maintained and minimum orders should be large enough to last for six months. Tar rope will be delivered to customers at cost or with a small mark-up to cover storage costs. The estimated annual requirement of tar rope is 60,000 metres at a cost of YR 0.83 per metre.

c. Fuel

53. The plant will be equipped with six diesel-powered vehicles (two pick-up trucks and four lift trucks) for internal transport of materials and products and external transport customers.

54. About five litres of diesel fuel per hour per vehicle will be needed. However, even at full capacity not all vehicles (particularly the pick-up trucks) will be in use at all times. Maximum diesel consumption is estimated at 48,000 litres per year. The present price of diesel fuel in the YAR is YR 0.9 per litre.

55. The plant will have a small diesel station with hand pumps and an underground storage tank.

## IV. PLANT LOCATION AND SITE

A. Plant Location

56. Four alternative locations have been examined for the concrete products plant:

1. Sana'a
2. Hodeidah, near the Baijil cement plant
3. Amran, near the cement plant
4. Taiz

1. Sana'a

57. Sana'a is the most obvious choice for the project's would-be sponsors (the Ministries of Municipalities and Public Works and private entrepreneurs). It has the largest share of the market as well as better infrastructure. Sana'a is 48 km from the new cement plent in Amran 1/, aggregates are abundant around the city, and road connections to other important urban centres are tolerable and slated to be improved. If private participation is accepted, there is at least one company in Sana'a producing ready-mix concrete that has the necessary land and some of the machinery and equipment plus considerable market experience.

58. The main disadvantage is water supply. Even if the concrete products plant has its own well, the water table is sinking so rapidly that steady water supply for the next ten years cannot be ensured. In general, salaries and wages are higher in Sana'a. Imported materials must be transported all the way from the port at Hodeidah. The dryness of the air (less than 50 per cent humidity) means that critical attention will have to be paid to the hardening process.

2. Hodeidah

59. A location near the Baijil cement plant would have the advantage of having cement and aggregates close to the concrete products plant. Water is not as great a problem as in Sana'a, although the closer to the coast the saltier the underground water becomes. The plant would be approximately 50 km from the port city of Hodeidah, which is becoming a booming industrial and trade centre that in time may even surpass Sana'a in economic importance.

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1/ There is a gypsum quarry 10 to 15 km north west of Sana'a (Al-Ehiras) to be considered as an alternative location. Since this quarry will supply gypsum to Amran, a new road connecting with the existing Amran-Sana'a road will save 20 to 30 km between the gypsum quarry and Amran. At present, trucks must travel from Amran to Sana'a and then north again to the gypsum quarry.

60. Granting that limestone could be used as aggregate, the granulometric composition of crushed stone for the cement plant is different and less rigorous than that for the concrete products plant, and additional crushing and grading equipment would be needed. Land and labour are more difficult to obtain in the Baijil area.

3. Amran

61. The country's largest cement plant is being built in Amran to take advantage of unlimited quantities of limestone in the area and the proximity to the large market of Sana'a. As in the case of Baijil, the concrete products plant would have the basic raw materials (cement and aggregates) close to hand and would benefit from proximity to a large urban centre.

62. The same disadvantages as those which apply for Baijil are found in Amran, namely the necessity of additional investment in crushing and grading equipment and serious difficulties in securing land and labour. For instance, land for the cement plant had to be expropriated by the Government, but there are many unsettled claims that could perhaps eventually be solved by compensating the owners with equity shares in the cement company.

4. Taiz

63. [illegible] the fact that it is a smaller urban centre than either Sana'a [illegible], Taiz has been developing an attractive econ[illegible] especially for industry, including the construction of ind[illegible] estates. The road to Sana'a is one of the best in the YAR, and the important cities of Ibb and Damar lie along it. Aggregates are readily available from several quarrying and crushing enterprises. The Government is seeking to promote the rapid economic development of Taiz and the neighbouring area, taking into account its proximity to the border with the People's Democratic Republic of Yemen and the strategic port of Aden.

64. The main disadvantage in locating the plant in Taiz is the long distance from the cement plants and the port of Hodeidah as well

as from the two largest potential markets, namely Sana'a and Hodeidah. The future may, however, see a third cement plant constructed at Mafrak near Taiz.

65. In general, and considering that both raw materials and finished products are heavy and bulky, transport costs within the YAR may be the decisive factor for the location of the plant. Should this be the case, the Sana'a-Amran area would be the best alternative.

B. Plant Site

66. A parcel of land of around 20,000 $m^2$, of regular shape, preferably flat and with good access to a main road and power transmission lines is recommended. Soil should have good characteristics with respect to load bearing capacity and ease of excavation. The land should not be susceptible to flooding, which does occasionally occur in certain sections of Sana'a and Taiz.

67. As already mentioned, land acquisition can be difficult in the YAR. If land is available, prices are very high, especially in the most densely populated cities. In areas surrounding Sana'a, for instance, prices of YR 6,000 - 7,000 per Libna (44.4 $m^2$) are considered normal at present. Careful consideration should also be given to the problem of water supply, including the drilling of a water well. Due to the lack of public facilities, a septic tank will have to be built for liquid waste disposal.

68. The total investment of YR 3.1 million (US$ 0.69 million equivalent) for land has been estimated based on a rate of YR 155 per square metre and is considered sufficient to cover land improvement, including fencing.

## V. PRODUCTION FACILITIES

### A. Production Programme and Plant Capacity

69. In accordance with the recommendations of the market study, the plant will include five production lines, the nominal capacity of which is defined as the production achievable while operating one eight hour shift per day, 300 days per year:

(1) Pipe 1: Concrete pipe of small diameter (200 to 500 mm), without reinforcement and with a capacity of 30,000 m per year.

(2) Pipe 2: Concrete pipe of large diameter (600 to 2,500 mm), with reinforcement and a capacity of 12,000 m per year.

(3) Concrete poles of lengths between 10 and 15 m and a capacity of 7,000 units per year.

(4) Cable blocks, with a capacity of 24,000 m per year.

(5) Pre-fabricated flat concrete slabs, kerbs and forms with a capacity of 14,400 tons per year.

The equipment and machinery selected for the above products have a larger nominal capacity by 30 per cent, but, due to the necessity of changing moulds and adjusting the equipment for each product differing in size or form or both, a lower capacity has been assumed.

70. Due to the initial tasks of ensuring market penetration, training personnel and establishing good relations with both suppliers and customers, it is assumed that production during the first, second and third years of operation will be 60 per cent, 75 per cent and 90 per cent of achievable capacity respectively. Full capacity would be reached by the fourth year.

71. Certain sections of the plant common to all production lines - concrete mixers and electric cranes - are over-dimensioned in order to

provide more flexibility and to facilitate operations. In the case of the former, concrete mixtures will be prepared according to different formulations for each product. In the case of the latter, the transportation of unhardened products to curing areas may present difficulties when all lines are working at the same time.

72. At this stage the computation of annual production has been prepared in global form only. Since the average specific gravity of the concrete is around 2.5 tons/$m^3$, total production would be:

Year 4: 24,000 $m^3$ x 2.5 tons/$m^3$ = 60,000 tons (full capacity)
Year 3: 90 per cent of year 4 = 54,000 tons
Year 2: 75 per cent of year 4 = 45,000 tons
Year 1: 60 per cent of year 4 = 36,000 tons

## B. Production Processes

73. The technology involved in the manufacture of concrete products is rather simple. The most critical points are the preparation of the concrete mixtures and the hardening of the semi-finished products. Careful control must be exercised over the quality of the raw materials, the exact formulation of the concrete mixtures and the conditions (humidity, temperature) in which hardening occurs. Quality control procedures must comply with DIN, ASTM, ISO or equivalent standards for the different products.[1/] Machinery and equipment should be designed to comply with these standards, as is the case of those included in the present prefeasibility study.

74. Due to the scarcity of labour and especially of skilled workers, various sections of the plant must be mechanized and/or equipped with automatic controls to an extent that is in line with the relatively small capacity of the various production lines.

75. The production processes for the various sections can be described briefly as follows:

### 1. Concrete Mixtures

76. Aggregates (sand and crushed stone graded to size) are stored

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1/ The YAR has no standards of its own.

in separate bins (or bays) from which the necessary amounts are measured carefully with an automatic scale and transferred to the concrete mixer. Cement from the silos is added in the same way. Water is introduced through a dosing device. The ingredients are mixed thoroughly in the machine. Chemical accelerators that reduce hardening time may also be used. The concrete is transported by belt conveyors from the mixer to the production lines.

2. Concrete Pipe and Cable Blocks

77. Concrete with the desired specifications is poured into moulds mounted around the vibrating core of the pipe machine. If reinforcement is indicated, the reinforcement cage is put between the external mould and the core. The vibration ensures that all the spaces between mould and core are filled with concrete. When the mould is full, another mould attached to a press produces the desired shape for the connecting end in the upper part of the pipe.

78. The pipe inside the mould and mounted on a wooden pallet is removed from the machine by means of an electric crane which transports the piece to the curing area, in which most of the hardening takes place. The outer mould is removed and cleaned thoroughly before being returned to the machine. Water is sprayed over the pipe during the hardening period, which may take either a few hours or up to two days, depending on the formulation of the concrete and thickness of the pipe.

79. After inspection, the pipe is transported with a lift truck to the storage area, where hardening is completed within seven to ten days, after which it is ready for use. Some water-spraying may be necessary during this period if the ambient temperature is too high and/or relative humidity too low.

80. The production of cable blocks entails a similar process, but the machine is equipped with several cores which need not, as in the case of pipe, be cylindrical, but which may have square, rectangular or oblong sections.

3. Concrete Poles and Pre-fabricated Slabs and Kerbs

81. The reinforcing bars with their attachments and supports are placed inside the moulds, which are then secured on a vibrating table. The concrete mixture is injected into the moulds until full. Any additional profile on the upper side of the concrete can be pressed before a crane takes the pieces to the demoulding and curing section. The rest of the process is similar to that for pipes.

4. Reinforcement Cages

82. The plant will be equipped with a workshop to prepare all the necessary reinforcements from steel rods and/or wire. Two automatic machines, one for small and one for large cages, will produce the steel assemblies in the desired dimensions. The cages will then be transported to the production lines, as needed.

C. Machinery and Equipment

83. The following machinery and equipment are proposed for the manufacture of the selected concrete products. The prices are based on quotations received in early 1981 from ten manufacturers in six different European countries. Transport costs to the YAR site were estimated at approximately 15 per cent of the fob prices.

| | YR '000 | US$ '000 Equivalent |
|---|---|---|
| (1) Plant for small diameter (200 to 500 mm) pipe (Pipe 1) | | |
| Complete with all accessories and automatic controls | 950.0 | |
| Moulds and couplings | 350.0 | |
| Installation | 150.0 | |
| Foundations | 216.7 | |
| Transport | 195.0 | |
| Total: | 1,861.7 | 413.7 |

| | | VR '000 | US$ '000 Equivalent |
|---|---|---|---|
| (2) | Plant for large diameter (600 to 2,500 mm) pipe (Pipe 2) | | |
| | Complete with all accessories and automatic controls | 733.3 | |
| | Moulds and couplings | 3,100.0 | |
| | Installation | 150.0 | |
| | Foundations | 283.4 | |
| | Transport | 575.0 | |
| | Total: | 4,841.7 | 1,075.9 |
| (3) | Plant for poles | | |
| | Complete with accessories, automatic controls and various moulds | 350.0 | |
| | Installation | 50.0 | |
| | Foundations | 33.3 | |
| | Transport | 50.0 | |
| | Total: | 483.3 | 107.4 |
| (4) | Plant for cable blocks | | |
| | Complete with accessories, automatic controls, including high frequency vibration system | 636.7 | |
| | Moulds and couplings | 233.3 | |
| | Installation | 133.3 | |
| | Foundations | 266.7 | |
| | Transport | 133.3 | |
| | Total: | 1,403.3 | 311.9 |

| | YR '000 | US$ '000 Equivalent |
|---|---|---|
| (5) Plant for pre-fabricated slabs and kerbs | | |
| Complete with vibration tables, conveyors, transport of excess material, etc. | 840.0 | |
| Moulds and accessories | 1,300.0 | |
| Foundations and rails | 350.0 | |
| Installation | 150.0 | |
| Transport | 321.7 | |
| Total: | 2,961.7 | 658.2 |
| (6) Two concrete mixing plants | | |
| Complete with conveyor belts, water dosing apparatus, automatic scale and controls | 933.3 | |
| 4 cement silos | 533.3 | |
| Construction of aggregate bins | 633.3 | |
| Foundations | 333.4 | |
| Installation | 150.0 | |
| Transport | 200.0 | |
| Total: | 2,783.3 | 618.5 |
| (7) Sand washing plant | | |
| Complete, including conveyor belts | 266.7 | |
| Settling basin for 100 $m^3$ of water, pumps, mud-trap and belt conveyors | 316.7 | |
| Installation | 33.3 | |
| Transport | 50.0 | |
| Total: | 666.7 | 148.1 |

| | YR '000 | US$ '000 Equivalent |
|---|---|---|
| (8) Plant for reinforcing cages | | |
| 1 machine for small reinforcing cages | 700.0 | |
| 1 machine for large reinforcing cages | 1,266.7 | |
| Installation | 100.0 | |
| Transport | 295.0 | |
| Total: | 2,361.7 | 524.8 |
| (9) Two electric cranes (20 tons) | | |
| Complete, including installation | 3,000.0 | |
| Railing | 166.7 | |
| Mobile roof | 200.0 | |
| Transport | 300.0 | |
| Total: | 3,666.7 | 814.8 |
| Total machinery and equipment: | 21,030.1 | 4,673.4 |

84. Of the total investment for machinery and equipment, the equivalent of US$ 4.3 million (92 per cent) will be needed in foreign currency. The remainder would be spent in local currency for foundations, part of the installation costs and internal transport to the plant site. All the machinery and equipment, with the exception of the plant for reinforcing cages, will be in the open and will not require additional construction.

85. The cost estimates make no provision for customs duties on imported plant and machinery, as the project is expected to receive approved investment status. Confirmatory opinions on duty exemption were given by several YAR Government officials.

D. Auxiliary Installations

86. The following auxiliary installations will be needed to implement the machinery and equipment:

| | YR '000 | US$ '000 Equivalent |
|---|---|---|
| 1 water-well, including pumping station and elevated reservoir of 300 $m^2$ with automatic level control | 900.0 | 200.0 |
| 1 transformer, 1,000 kVA, including distribution panel and automatic controls | 306.7 | 68.1 |
| 1 diesel station, including hand pump and underground tank | 50.0 | 11.1 |
| Equipment and tools for workshops, including welding machine, small lathe, crane, drills, etc. | 90.0 | 20.0 |
| Laboratory and testing equipment, including concrete testing machine | 45.0 | 10.0 |
| Total auxiliary installations: | 1,391.7 | 309.3 |

The entire investment for auxiliary installations will require foreign currency.

E. Vehicles

87. All vehicles for transporting work in process and finished products inside and outside the plant will be equipped with diesel motors, diesel being a cheaper fuel in the YAR than either gasoline or electricity.

| Requirements are: | YR '000 | US$ '000 Equivalent |
|---|---|---|
| 4 lift trucks, with net capacity 2 tons @ YR 157,000 | 630.0 | 140.0 |
| 2 pick-up trucks with net capacity one ton @ YR 54,000 | 108.0 | 24.0 |
| Total vehicles | 738.0 | 164.0 |

88. The project assumes that raw materials will be delivered by suppliers' trucks and that customers will make their own arrangements to transport the concrete products from plant to construction sites, as is the customary arrangement between the suppliers of construction materials and building contractors. Alternatively, transportation might be sub-contracted with local firms or individuals. In any case, the price of raw materials used in the project include transportation costs, and selling prices are net of transportation costs.

89. The cement silos are portable and can be mounted on a truck platform.

## F. Buildings and Construction

90. Examples of current construction costs in the YAR are:

| | Unit | YR |
|---|---|---|
| Concrete buildings | $m^2$ | 1,200 |
| Concrete pavement | $m^2$ | 168 |
| Steel roofing | $m^2$ | 200 |
| Ready-mix concrete | $m^3$ | 700 |

91. The following construction will be needed for the concrete products plant:

### Office Building

92. The office building will be built of concrete with a total area of 550 $m^2$, including office space for the general manager, production manager and six accounting, administrative and clerical staff. A canteen, showroom, first aid clinic and meeting room are also included.

### Personnel and Services Building

93. This building will also be of concrete and will have a total area of 300 $m^2$, including a locker room for around 40 workers, a laboratory, the water pumping station and the transformer station.

Workshop and Warehouse

94. Two adjacent buildings, built of concrete and with a total area of 500 $m^2$, will be needed. The larger building (300 $m^2$) will be used as a warehouse, and the other will accomodate a workshop for electrical and mechanical repairs and maintenance.

Guard House

95. A concrete house of about 50 $m^2$, including living quarters, will be built for the watchman.

Concrete Paved Areas

96. A surface of 1,380 $m^2$ will be paved with concrete, including space for a storage area, the reinforcement plant, the garage and the gas station.

Steel-Roofed Areas

97. A total area of 1,620 $m^2$ will be covered with corrugated steel plate (galvanized iron) to protect the reinforcement plant, the garage and part of the finished products storage area.

Fencing

98. Since the plant site has not yet been selected, fencing is included in the land investment.

Summary of Buildings and Construction

99. The total investment in buildings and construction is needed in local currency, as overleaf:

| | Concrete Buildings | Concrete Paved Areas | Steel Roofs | Total Cost |
|---|---|---|---|---|
| | $m^2$ | $m^2$ | $m^2$ | |
| Production (foundations included in machinery costs) | - | - | - | |
| Office | 550 | - | - | |
| Personnel and Services | 300 | - | - | |
| Guard House | 50 | - | - | |
| Workshop | 200 | - | - | |
| Warehouse | 300 | - | - | |
| Reinforcements Plant | - | 500 | 500 | |
| Curing Area | - | 660 | - | |
| Storing Area | - | - | 900 | |
| Garage | - | 200 | 200 | |
| Gas Station | - | 20 | 20 | |
| Total: | 1.400 | 1,380 | 1,620 | |
| YR '000 | 1,680 | 232 | 324 | 2,236 |
| US$ '000 equivalent | 373.3 | 51.6 | 72.0 | 496.9 |

Plant Layout

100. The recommended plant layout is shown in Annex 13, while Annexes 14 through 19 contain diagrams of the major items of machinery and equipment.

## G. Other Assets

101. Preliminary expenses included in the capital expenditure budget amount to YR 2,275,000 (US$ 505,556 equivalent) and are as follows:

Pre-investment Costs

102. Pre-investment expenses foreseen amount to YR 225,000 for company formation, preparation of design specifications, and procurement of plant through international competitive bidding.

Pre-production Costs

103. Pre-production costs are estimated at YR 800,000 to cover management, administrative, travel and other expenses during the construction period.

Training

104. YR 350,000 is allocated to the training programme which includes two expatriate instructors (a production engineer and a qualified mechanic) for four months each. Together with representatives of the machinery suppliers, they will be responsible for training local counterparts, for establishing production, quality control and maintenance procedures, and for plant commissioning. There is also provision for further training and the acquisition of expertise, including expatriate staff, after the start of operations. This is included in the annual administration, know-how and contingencies budget of YR 1.04 million in the first year of operation, rising to YR 1.56 million from the fourth year onward.

Interest during Construction

105. The YR 24.3 million loan is drawn at intervals from the fourth month of construction onwards, incurring interest at 10 per cent per annum. Interest payable amounting to YR 900,000 at the end of the twelve month period is capitalized and included under Other Assets.

## VI. MANPOWER

### Labour

106. It is estimated that at least one million Yemenis have emigrated to neighbouring Saudi Arabia in search of jobs, and this has created a tight labour market. The labour shortage prevalent in the YAR results in high wages. Although the problem of labour shortage is more noticeable for skilled workers, it also affects the supply of non-skilled workers. For this reason, the concrete products plant has been designed to operate with a minimum of workers. The full labour force will be utilized from the first year of operation, in order to allow for training and for lower productivity during the first three years. From the fourth year onward, however, labour productivity and plant capacity utilization should reach normal levels and there should be no need to employ more workers. Manpower for the different sections of the plant is indicated in the following table:

| | Skilled | Semi-skilled | Non-skilled | Total |
|---|---|---|---|---|
| Reinforcement plant | 1 | 2 | 1 | 4 |
| Concrete mixers | 2 | - | - | 2 |
| Pipe plant | 1 | 3 | 8 | 12 |
| Poles plant | 1 | 3 | 6 | 10 |
| Flat products plant | 1 | 2 | 6 | 9 |
| Total | 6 | 10 | 21 | 37 |

The YAR does not have a social security system. Workers receive their wages per day worked. The project assumes that each worker will receive an annual salary equivalent to 300 days of work (25 working days per month).

106. The wages assumed for the computation of labour costs are those prevalent in Sana'a, which may be higher than in other parts of the country, i.e. YR 240, 120 and 70 per day for skilled, semi-skilled and non-skilled workers respectively.

ESTIMATED WAGES

| | No. | YR Per Day Per Worker | Total per Year YR | Total per Year US$ Equivalent |
|---|---|---|---|---|
| Skilled (Machine Operators) | 6 | 240 | 432,000 | 96,000 |
| Semi-skilled (Operator Assistants) | 10 | 120 | 360,000 | 80,000 |
| Non-skilled (Workers) | 21 | 70 | 441,000 | 98,000 |
| Sub-total | 37 | | 1,233,000 | 274,000 |
| Surcharge (10%) 1/ | | | 123,300 | 27,400 |
| Total | 37 | | 1,356,300 | 301,400 |

Annual Wages by Product Line 2/

| | YR | | | |
|---|---|---|---|---|
| | Skilled | Semi-skilled | Non-skilled | Total |
| Pipe 1 | 31,680 | 28,512 | 36,960 | 97,152 |
| Pipe 2 | 235,224 | 193,644 | 234,927 | 663,795 |
| Poles | 58,608 | 48,312 | 58,674 | 165,594 |
| Cable Blocks | 31,680 | 28,512 | 36,960 | 97,152 |
| Slabs, Kerbs, etc. | 118,008 | 97,020 | 117,579 | 332,607 |
| Total | 475,200 | 396,000 | 485,100 | 1,356,300 |

1/ In the YAR there are neither social security nor fringe benefits nor bonuses. The 10 per cent surcharge is for vacation and other amenities.

2/ Same percentages as salaries, with the exception of 1 skilled, 2 semi-skilled and 1 non-skilled workers belonging to the reinforcement shop, where wages are prorated 57 per cent for large diameter pipe, 14 per cent for poles and 29 per cent for slabs, kerbs, etc.

B. Staff and Training

108. As in the case of labour, qualified personnel are difficult to find and retain, even when paid high salaries as an incentive. A total of 14 persons will be required for the concrete products plant, as indicated in the following:

| | |
|---|---|
| General manager | 1 |
| Production manager | 1 |
| Sales clerks | 2 |
| Accountants | 2 |
| Administrative clerks and secretaries | 3 |
| Laboratory assistants | 2 |
| Mechanic | 1 |
| Electrician | 1 |
| Watchman | 1 |
| Total | 14 |

Salaries are the same those prevailing in Sana'a. It may be more difficult to find qualified personnel in locations such as Amran and Baijil, where higher salaries would probably have to be paid as an incentive.

ESTIMATED SALARIES

| | No. | YR Per Month Per Employee | Total per Year YR | Total per Year US$ Equivalent |
|---|---|---|---|---|
| General Manager | 1 | 10,000 | 120,000 | 26,667 |
| Production Manager | 1 | 10,000 | 120,000 | 26,667 |
| Clerks (sales) | 2 | 4,500 | 108,000 | 24,000 |
| Clerks (accountants and administration) | 5 | 4,400 | 264,000 | 58,667 |
| Clerks (laboratory) | 2 | 4,500 | 108,000 | 24,000 |
| Technician (mechanic) | 1 | 6,000 | 72,000 | 16,000 |
| Technician (electrical) | 1 | 6,000 | 72,000 | 16,000 |
| Watchman | 1 | 3,000 | 36,000 | 8,000 |
| Sub-total | 14 | | 900,000 | 200,000 |
| Surcharge (10%)[1/] | — | | 90,000 | 20,000 |
| Total | 14 | | 990,000 | 220,000 |

1/ In YAR there are neither social security nor fringe benefits nor bonuses. The 10 per cent surcharge is for vacation and other amenities.

## ESTIMATED SALARIES

Annual Salaries by Produc' Line

| | YR | % |
|---|---|---|
| Pipe 1 | 79,200 | 8 |
| Pipe 2 | 475,200 | 48 |
| Poles | 118,800 | 12 |
| Cable blocks | 79,200 | 8 |
| Pre-fabricated Pieces | 237,600 | 24 |
| | 990,000 | 100 |

Apart from the provision of YR 350,000 for training costs in the capital expenditure estimate, there is an allocation in the operating costs for administration, know-how and contingencies of YR 1.04 million in the first year of operation rising to YR 1.56 million in the fourth and following years. Part of this is intended to cover further training of personnel and the acquisition of know-how, including expartriate staff.

## VII. PROJECT IMPLEMENTATION

109. Judging by the interest shown during the field mission in the YAR, this study envisages that both Government development institutions and private sector investors will be interested in undertaking the project, perhaps jointly. In view of the scarcity of expertise in the YAR to plan and supervise the construction of a large manufacturing facility, the procurement of the factory on a turn-key basis and/or the employment of engineering consultants may be desirable. Estimates for individual sections of the plant are included to enable separate product costing. The capital costs include design, procurement and supervision of construction of the factory as it would be undertaken by a turn-key supplier.

Alternatively, engineering consultants could be employed to plan, design and execute the construction of the factory on behalf of the company if it had one or more major shareholders with adequate administrative experience. This would largely depend on the inclusion of a Government development institution or an experienced private sector group among the major investors. The capital expenditure estimate, including the plant quotations and more than 25 per cent price escalation and contingency elements, should be sufficient to cover this alternative.

International competitive bidding

110. In view of the need for external long-term financing, the negotiation of a contract to prepare the final design of the project and to build the plant should be carried out through international competitive bidding, following the guidelines set out by and under the supervision of the financing agencies. Technical assistance may be required for the preparation of terms of reference and tender documents and for the processing and selection of bids.

Construction of the plant

111. Final selection of the plant site and land acquisition would be made following the recommendations of the contractor or consultant. The physical construction of the plant would be relatively simple because most of the installations will be in the open air and hence require only services and foundations. Simple constructions could be sub-contracted to local firms. The critical elements are the financial plan and the placing of orders for machinery and equipment with due anticipation.

Training, production trials and start-up

112. Training of executives, key workers and technicians must be undertaken during the construction period, so that they are able to participate in production trials and start-up operations. The advantage of having a turn-key contract is that the training of personnel, the start-up and the running of operations during the first four to six months falls under the responsibility of the contractor. The expatriate experts provided

by the contractor would also exercise the necessary control. The gradual build-up of production capacity from 60 per cent to 100 per cent in four years would be sufficient to complete the training of workers, to develop markets and distribution channels, and to establish an efficient system of production programming.

## I. FINANCIAL EVALUATION

### Capital Costs

113. A contingency allowance of 10 per cent and price escalation of 12.5 per cent are applied to the unit fixed asset costs, listed in chapter V, to arrive at the estimated investment costs. These are shown in the Capital Investment Cost Estimate at Annex 4, which also summarizes the Working Capital Estimated, shown at Annex 5. The total investment cost is estimated at YR 40.5 million, as follows:

Capital Cost Summary

| | Cost incl. Contingencies and Escalation YR'000 | US$ '000 Equivalent |
|---|---|---|
| Fixed Assets | 34,908 | 7,757 |
| Other (Intangible) Assets | 2,275 | 506 |
| Total Fixed Investment | 37,183 | 8,263 |
| Working Capital | 3,317 | 737 |
| Total Investment Cost | 40,500 | 9,000 |

### Operating Costs

114. The main raw materials and other inputs and their unit prices are, at full production:

Raw Materials and Other Inputs

| | Annual Quantity | Unit Price in YR |
|---|---|---|
| Cement | 8,750 tons | 604/ton |
| Sand and aggregated | 32,500 $m^3$ | 100/$m^3$ |
| Reinforcing steel (imported) | 1,500 $m^3$ | 2,700/ton |
| Tar rope (imported) | 60,000 m | 0.83/m |
| Water, from factory borehole | 90,000 $m^3$ | - |
| Electricity (31 kWh/ton of concrete) | 1,920 MWh | 1.0/kWh |
| Diesel fuel | 48,000 litres | 0.9/litre |

115. Wages and salaries, as estimated in Chapter VI, amount to YR 1,356,000 and YR 990,000 respectively.

116. The provision for administration, know-how and contingencies is YR 1,599,000, including an allowance for training, and acquisition of foreign expertise.

117. Maintenance, repair and spare parts expenditure has been estimated as a percentage of the initial investment:

Maintenance and Repair

| | % of Investment | YR'000 Year 4 |
|---|---|---|
| Buildings | 1 | 22 |
| Machinery and equipment[1/] | 3 | 347 |
| Concrete plant | 3 | 83 |
| Sand Washing plant | 3 | 20 |
| Reinforcement plant | 3 | 71 |
| Electric cranes | 3 | 110 |
| Auxiliary installations | 3 | 42 |
| Vehicles | 5 | 37 |
| Contingencies, escalation | 3 | 223 |
| Average/Total | 3% | 955 |

1/ Machinery and equipment for the five product lines.

118. Insurance premia are calculated applying the following rates to the initial investment:

Insurance

| | % of Investment | YR'000 Year 4 |
|---|---|---|
| Buildings | 1 | 22 |
| Machinery and equipment | 3 | 634 |
| Auxiliary installations | 2 | 28 |
| Vehicles | 3 | 22 |
| Contingencies, escalation | 3 | 223 |
| Average/Total | 2.4% | 929 |

The insurance and also the maintenance and repair provisions are allocated to each of the five product lines according to the utilization of fixed assets.

119. Operating costs are shown in some detail at Annex 6, and are summarized below, in total and by product at full production:

Annual Operating Costs in Year 4 at Full Production

(YR)

| | Small Pipe | Large Pipe | Poles | Cable Blocks | Kerbs, Slabs etc. | Total |
|---|---|---|---|---|---|---|
| Net Output | | | | | | |
| Tons | 4,800 | 28,000 | 7,200 | 4,800 | 14,400 | 60,000 |
| Operating Costs | | | | | | |
| Raw materials, power and fuel | 953 | 8,539 | 2,083 | 913 | 2,775 | 15,263 |
| Wages and salaries | 176 | 1,139 | 285 | 176 | 570 | 2,346 |
| Administration, training, etc. | 156 | 764 | 156 | 140 | 343 | 1,559 |
| Maintenance and repairs and insurance | 187 | 923 | 189 | 169 | 414 | 1,882 |
| Total (before depreciation and interest) | 1,472 | 11,365 | 2,713 | 1,398 | 4,102 | 21,050 |
| YR/ton | 307 | 406 | 377 | 291 | 285 | 351 |

Sales Income

120. The proposed sales prices take into consideration the local market prices of asbestos-cement pipes (other products are not yet available, apart from building blocks, low quality pipe, etc.), comparative prices in Austria, and the estimated production costs of the project in 1981/82.

Annual Sales Values by Product

| | From Year 4 onward at full production | | |
|---|---|---|---|
| | YR/ton | Tons | YR'000 |
| Pipe, small dia. | 460 | 4,800 | 2,208 |
| Pipe, large dia. | 640 | 28,800 | 18,432 |
| Poles | 560 | 7,200 | 4,032 |
| Cable blocks | 440 | 4,800 | 2,112 |
| Slabs, kerbs, etc. | 400 | 14,400 | 5,760 |
| Average/Total | 542 | 60,000 | 32,544 |

Projected Income Statement

121. The foregoing operating costs and sales values are summarized over 15 years of operation at Annex 8. After allowing for the necessary increases in raw materials and finished inventories, and in accounts receivable less accounts payable, the operating cash flow is shown year by year at line 10.

122. The Projected Income Statement also records the profitability of the project year by year from line 11 onward, based on the financial plan which is explained in chapter X.

Assumptions

123. The main assumptions relating to the financial projections are stated at Annex 7.

Internal Rate of Return

124. The internal rate of return of the project is calculated at Annex 11, based on the estimated initial capital expenditure plus replacement expenditures in years 6 and 12 and cash flow over the first fifteen years of operation. The resulting rate of return is 18.8 per cent. The pay back period for the total initial capital expenditure is a little over five years.

Sensitivity Analysis

125. The sensitivity analysis at Annex 12 shows the effect on the financial rate of return of changing the price and other parameters of the project. So as to conform with other capital intensive projects, the internal rate of return is calculated over 15 years. The 18.8 per cent rate of return is, however, not severely eroded over a shorter period and is 16.6 per cent over ten years. The return is sensitive to production and sales volume, a drop of only 10 per cent below budget reducing the return to 15.7 per cent. At 20 per cent below budget, the return is 12.3 per cent. Continuation of production at 75 per cent of capacity, instead of rising to 90 per cent in year 3 and 100 per cent from year 4 onward, brings the rate down to 12.5 per cent. Over half of the sales value is contributed by the reinforced pipe production, which, if reduced by half, would have a serious effect on viability, with a rate of return of only 9.0 per cent. Changes in raw material, power and personnel costs are less significant but a change of $\pm$ 10 per cent in the sales price affects the return by over 5 per cent.

## IX. ECONOMIC BENEFITS

126. These products are not yet made in the country, and the economic cost of importing such heavy, bulky items or substituting other construction materials appears to be equivalent to or greater than the cost of local production. Without these construction materials, the road, sewerage, electricity and other infrastructure projects could be severely constrained.

127. Benefits to the economy resulting from the project include:

(1) Use of domestic resources. Raw materials and energy to a value of about YR 11.2 million will be consumed annually, and wage and salary payments will be about YR 2 million.

(2) Production of basic construction materials will be expanded to include high-quality concrete products which will improve the country's infrastructure and living standards.

(3) Reduction of imports of asbestos-cement pipe, now between YR 10 and YR 15 million a year, and of wooden poles, currently about YR 2 million a year.

(4) Reduction of public works costs, as the plant will supply products which are bulky and expensive to import and which are more durable and require less maintenance than the substitute materials available locally.

(5) Propagation of technology. The experience and expertise gained in the operation of this first mechanized concrete products plant will further the development of this industry in the YAR. It will enable the Ministry of Public Works and the construction sector as a whole to benefit from a greater range and improved specifications of concrete products.

128. The foreign exchange benefits deriving from the project cannot be calculated with accuracy because similar or substitute materials are not imported.

## X. RETURN ON INVESTMENT

129. The foregoing financial evaluation, which is independent of the financial plan, is indicative of the combined return which will be available, before tax, to the shareholders and to the providers of loan finance. The favourable terms on which loans are available for suitable projects from equipment suppliers and international agencies can have an additional favourable impact on the return to the shareholders.

130. It is recommended that 40 per cent of the total investment (YR 40.5 million or US$ 9.0 million equivalent) should be in equity and the balance in long-term loans. Thus the equity is YR 16.2 million and loans amount to YR 24.3 million. The loans are expected to be in foreign currency, equivalent to US$ 5.4 million. This would cover most of the direct foreign exchange costs of the project, leaving a balance of about US$ 1.1 million to be provided by foreign shareholders (32 per cent of the share capital), or alternatively from official sources. The estimated project costs and the proposed financial plan are as follows:

Estimated Local and Foreign Currency Costs

| | Total Cost YR '000 | | Estimated Local Currency YR '000 | | Estimated Foreign Currency YR '000 | |
|---|---|---|---|---|---|---|
| Fixed Investment | 37,183 | 100% | 9,270 | 25% | 27,913 | 75% |
| Working Capital | 3,317 | 100% | 1,778 | 54% | 1,539 | 46% |
| Total | 40,500 | 100% | 11,048 | 27% | 29,452 | 73% |
| Total US$ '000 equivalent | 9,000 | | 2,445 | | 6,545 | |

Financial Plan

| | Total Finance YR '000 | | Local Currency YR '000 | | Foreign Currency YR '000 | |
|---|---|---|---|---|---|---|
| Equity | 40% | 16,200 | 11,048 | 68% | 5,152 | 32% |
| Long-term Loans | 60% | 24,300 | - | - | 24,300 | 100% |
| Total YR '000 | 100% | 40,500 | 11,048 | 27% | 29,452 | 73% |
| Total US$ '000 equivalent | | 9,000 | 2,445 | | 6,545 | |

131. For this project the foreign currency loans are assumed to bear interest at 10 per cent per annum, with repayment amortized over eight years following a two year grace period. Interest charges and repayments of principal are detailed below:

Amortization Schedule
(YR '000)

| Year | Outstanding Balance | Interest[1/] | Repayments of Principal | Total Instalment |
|---|---|---|---|---|
| 0 | 24,300 | 900 | | 900 |
| 1 | 24,300 | 2,430 | | 2,430 |
| 2 | 22,175 | 2,430 | 2,125 | 4,555 |
| 3 | 19,838 | 2,218 | 2,337 | 4,555 |
| 4 | 17,267 | 1,984 | 2,571 | 4,555 |
| 5 | 14,439 | 1,727 | 2,828 | 4,555 |
| 6 | 11,328 | 1,444 | 3,111 | 4,555 |
| 7 | 7,906 | 1,133 | 3,422 | 4,555 |
| 8 | 4,142 | 791 | 3,764 | 4,555 |
| 9 | - | 414 | 4,142 | 4,555 |

1/ Allocation of interest charges for the purpose of determining the profitability of individual product lines is, as with depreciation, in accordance with the cost of fixed assets employed, i.e. 10 per cent, 40 per cent, 10 per cent, 9 per cent, and 22 per cent for the respective product lines.

132. The Projected Income Statement, Annex 8, summarizes the operating profits during the first fifteen years of operation (Line 11). Depreciation and amortization, and interest charges in accordance with the above schedule, are deducted to arrive at profit before tax. Tax is assessed from year six onwards (payable in the following year) to arrive at profit after tax. The amount available for dividends (Line 18) is determined after providing sufficient working capital. The Projected Balance Sheet and Projected Statement of Source and Application of Funds are at Annexes 9 and 10 respectively.

133. With exemption from profits tax during the first five years of operation (Law No. 12 of 1970), dividends on the YR 16.2 million share capital would be payable in the following percentages:

| Year | % |
|---|---|
| 3 | 25 |
| 4 | 37 |
| 5 | 43 |
| 6 - 10 | 29 |
| 11 - 15 | 43 |

134. The estimated return on shareholders' equity over the years after tax and interest have been paid is as follows:

| Year | Profit after Tax (YR '000) | Average Shareholders' Equity (YR '000) | % return |
|---|---|---|---|
| 1 | (318) | 16,041 | - |
| 2 | 1,844 | 16,804 | 11.0 |
| 3 | 4,403 | 17,928 | 24.6 |
| 4 | 6,140 | 18,199 | 33.7 |
| 5 | 6,397 | 17,968 | 35.6 |
| 6 | 3,940 | 17,136 | 23.0 |
| 7 | 4,213 | 16,562 | 25.4 |
| 8 | 4,435 | 16,687 | 26.6 |
| 9 | 4,680 | 17,174 | 27.3 |
| 10 | 4,900 | 16,847 | 29.1 |
| 11 - 15 | 6,910 | 16,200 | 42.6 |

# YAR: CONCRETE PRODUCTS PLANT

## COUNTRY DATA

| AREA | POPULATION | DENSITY (1979) |
|---|---|---|
| 195,000 sq. km. | 5.8 million (end 1979)<br>Rate of Growth: 2.9 percent | 30 per sq. km. |

**POPULATION CHARACTERISTICS (1978)**

| | |
|---|---|
| Crude birth rate (per 1,000) | 48 |
| Crude death rate (per 1,000) | 25 |

**ACCESS TO SAFE WATER (1977)**

| | |
|---|---|
| Occupied dwellings without safe water (%) | 96 |

**NUTRITION (1977)**

| | |
|---|---|
| Calorie intake as percent of requirements | 91 |
| Per capita protein intake (grams/day) | 68 |

**HEALTH (1978/79)**

| | |
|---|---|
| Population per physician | 12,510 |
| Population per hospital bed | 2,065 |

**ACCESS TO ELECTRICITY (1977)**

| | |
|---|---|
| % of urban population | 57 |

**EDUCATION (1977)**

| | |
|---|---|
| Adult literacy rate percent | 13 |
| Primary school enrollment percent | 26 |

**GNP PER CAPITA IN 1977/78 : $ 410 1/**

**NATIONAL ACCOUNTS (US$ Mln)**
**(1978/79 Prices)**

| | 1978/79 2/ | ANNUAL RATE OF GROWTH (Constant prices) FY73-79 |
|---|---|---|
| GNP at Market Prices | 3,810 | 13 |
| GDP at Market Prices | 2,800 | 10 |
| Gross Domestic Investments | 900 | 33 |
| Gross National Savings | 524 | 27 |
| Exports of GNFS | 107 | 10 |
| Imports of GNFS | 1,490 | 28 |

**GOVERNMENT FINANCE (YRls Mln)**

| | 1975/76 | 1976/77 | 1977/78 | 1978/79 | % of GNP 1978/79 |
|---|---|---|---|---|---|
| Current Revenue | 605 | 1,293 | 1,985 | 2,188 | 13 |
| Current Expenditure | 617 | 841 | 1,250 | 1,840 | 11 |
| Current Deficit/Surplus | -12 | 452 | 735 | 348 | 2 |
| Capital Expenditure | 361 | 603 | 1,167 | 2,670 | 16 |
| External Assistance, Net | 635 | 606 | 697 | 1,904 | 11 |

**MONEY CREDIT AND PRICES**

| | YRls Million Outstanding End Period | | | |
|---|---|---|---|---|
| Money Supply | 2,509 | 4,370 | 6,205 | 7,583 |
| Bank Credit to Govt. Sector, net | -407 | -939 | -990 | -609 |
| Bank Credit to Non-Govt. Sector | 566 | 1,474 | 1,555 | 2,199 |
| | Percentages | | | |
| Annual Percentage Increase in: | | | | |
| Money Supply | 120 | 74 | 42 | 22 |
| Consumer Price Index | 17 | 24 | 19 | 22 |

1/ Calculated by the World Bank Atlas conversion technique.
All other conversions to dollars in this table are at the average exchange rate prevailing during the period covered.

2/ Tentative World Bank estimates

# YAR: CONCRETE PRODUCTS PLANT

## COUNTRY DATA

BALANCE OF PAYMENTS (US$ Mln)

| | 1972/73 | 1975/76 | 1976/77 | 1977/78 | 1978/79 |
|---|---|---|---|---|---|
| Exports of Goods, fob | 7 | 12 | 19 | 7 | 3 |
| Imports of Goods, cif | 120 | 382 | 730 | 906 | -1,405 |
| Trade Balance | -113 | -370 | -711 | -899 | -1,402 |
| Non Factor Services, Net | -11 | 21 | -10 | -21 | 19 |
| Factor Income, Net | 105 | 479 | 896 | 1,160 | 1,007 |
| Workers' Remittances, Net | (102) | (457) | (842) | (1,090) | (898) |
| Investment Income, Net | (3) | (22) | (54) | (70) | (109) |
| Balance on Current Account | -19 | 130 | 175 | 240 | -376 |
| M & LT Capital, Net | 22 | 153 | 146 | 165 | 435 |
| Official Grants, Net | 14 | 114 | 104 | 103 | 312 |
| Official Loans, Net | 8 | 39 | 42 | 62 | 123 |
| Disbursements | (12) | (42) | (46) | (68) | (133) |
| Repayments | (-4) | (-3) | (-4) | (-6) | (-10) |
| Other Capital (including errors and omissions), Net | 25 | -11 | 133 | -32 | 144 |
| Increase in Reserves (-) | -28 | -272 | -454 | -373 | -203 |
| Gross Reserves (end FY) | 65 | 520 | 974 | 1,347 | 1,550 |

EXTERNAL PUBLIC DEBT, JUNE 30, 1979

| | US$ Mln. |
|---|---|
| Total Commitments | 1,075 |
| Of which Disbursed | 543 |

MERCHANDISE EXPORTS
(Average 1976/77-1978/79)

| | % |
|---|---|
| Cotton & Cotton Products | 2 |
| Coffee | 5 |
| Hides & Skins | 16 |
| Biscuits & Confectionary | 20 |
| All other Commodities | 57 |
| | 100 |

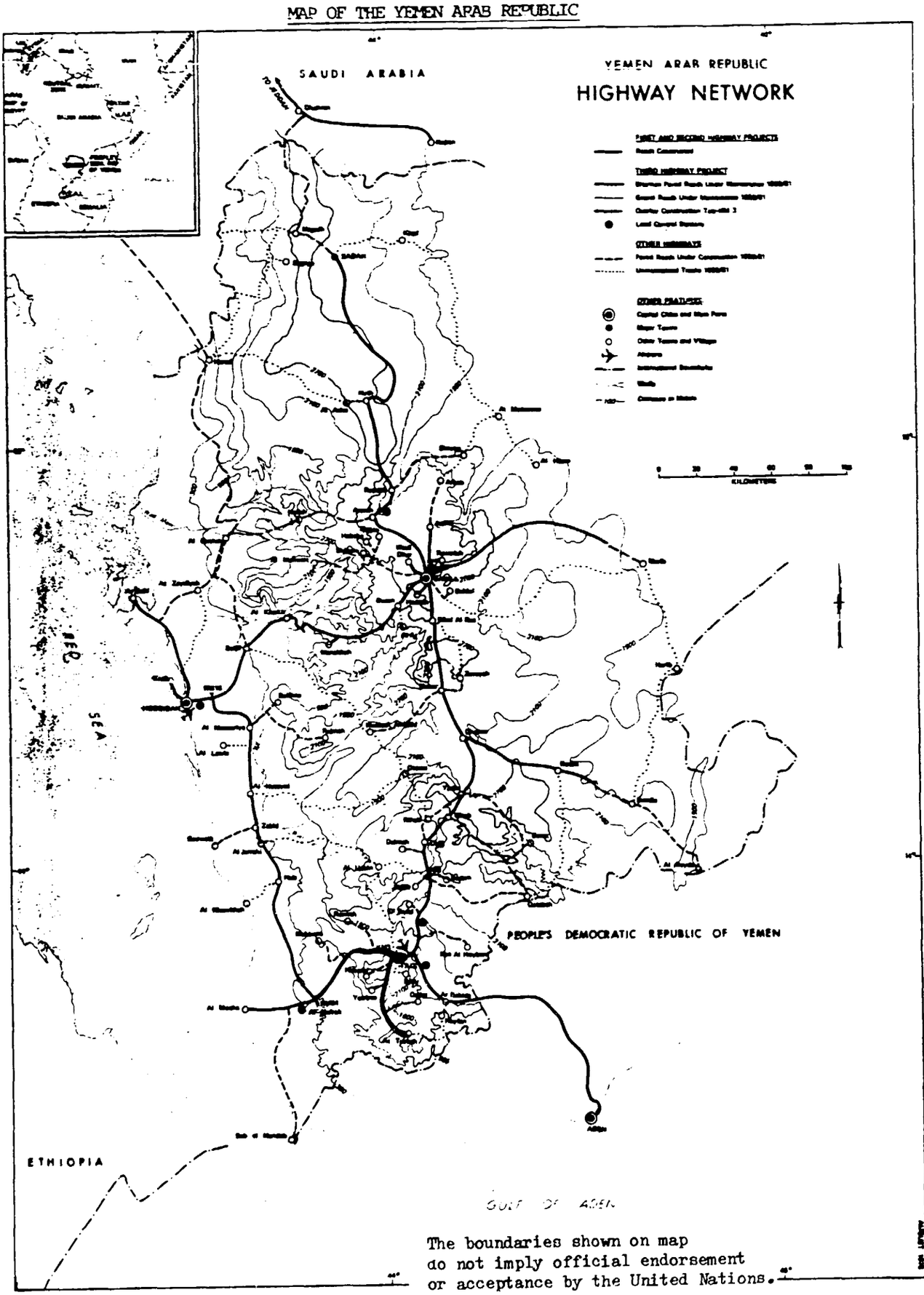
DEBT SERVICE RATIO FOR 1978/79: 1.7% 1/

1/ Includes workers' remittances.

Source: World Bank Report No. 2856 - YAR, October 23, 1980.

YAR: CONCRETE PRODUCTS PLANT

MAP OF THE YEMEN ARAB REPUBLIC



YAR - Concrete Products Plant

Market Data - Austria[1/]

| Concrete Pipe | Diameter mm | kg/metre | YR/metre[2/] | YR/ton[2/] |
|---|---|---|---|---|
| Standard, non-reinforced | 200 | 58 | 17 | 300 |
| | 250 | 79 | 21 | 270 |
| | 300 | 115 | 25 | 220 |
| | 350 | 140 | 31 | 230 |
| | 400 | 195 | 39 | 200 |
| | 500 | 270 | 55 | 210 |
| | 600 | 350 | 75 | 220 |
| | 800 | 640 | 108 | 170 |
| | 1,000 | 1,040 | 175 | 170 |
| Eccentric, non-reinforced | 1,000 | 1,660 | 330 | 200 |
| | 1,200 | 2,140 | 490 | 230 |
| | 1,500 | 3,300 | 670 | 200 |
| Standard, reinforced | 600 | 550 | 305 | 560 |
| | 800 | 707 | 560 | 790 |
| | 1,000 | 1,153 | 910 | 790 |
| | 1,300 | 1,494 | 1,220 | 820 |
| | 1,500 | 1,943 | 1,590 | 820 |
| | 1,700 | 2,179 | 1,710 | 780 |
| | 2,000 | 2,990 | 2,110 | 710 |
| | 2,200 | 3,950 | 2,520 | 640 |
| | 2,500 | 5,900 | 3,960 | 670 |

Concrete Poles — Average price AS 2,000/ton (=YR 600/ton)
10 metre pole, 980 kg, YR 588 per pole
15 metre pole, 1,250 kg, YR 750 per pole

| Cable Blocks (one metre long) | kg/block | YR/block | YR/ton |
|---|---|---|---|
| | 45 | 30 | 670 |
| | 69 | 45 | 650 |
| | 92 | 57 | 620 |

| Slabs, kerbs, etc. | | | |
|---|---|---|---|
| Slabs (AS 0.9/kg) | | | 270 |
| Kerbs | 85 | 17 | 205 |
| Water channels | 65 | 31 | 480 |

---

1/ Not including 18 per cent value added tax applicable to domestic sales.

2/ At US$ 1 = Austrian Schilling 15.00 = YR 4.50
AS 3.33 = YR 1.00

Source: Mr. Günter Appel, consultant

March 1981

# YAR - Concrete Products Plant

## Capital Cost Estimate

| | Estimated Costs (1981 Prices) YR '000 | Cost incl. Contingencies and Escalation YR '000 | US$ '000 Equivalent |
|---|---|---|---|
| **Fixed Assets** | | | |
| A) Land 20,000 $m^2$ | 3,100 | 3,798 | 844 |
| B) Buildings, etc. | 2,236 | 2,739 | 608 |
| C) Machinery and equipment for: | | | |
| Pipe, 200 to 500 mm dia. | 1,862 | 2,281 | 507 |
| Pipe, 500 to 2,500 dia. | 4,842 | 5,932 | 1,318 |
| Poles | 483 | 592 | 132 |
| Cable blocks | 1,403 | 1,719 | 382 |
| Pre-fabricated pieces | 2,962 | 3,628 | 806 |
| Concrete mixing, etc. | 2,783 | 3,409 | 757 |
| Sand washing | 667 | 817 | 182 |
| Reinforcing steel cages | 2,362 | 2,893 | 643 |
| Cranes and rails | 3,666 | 4,491 | 998 |
| Sub-total | 26,366 | 32,299 | 7,177 |
| D) Auxiliary Installations | 1,392 | 1,705 | 379 |
| E) Vehicles | 738 | 904 | 201 |
| Total estimated cost | 28,496 | | |
| Contingencies 10% 2,850<br>Escalation 12.5% 3,562 | 6,412 | | |
| Total fixed assets incl. contingencies and escalation | 34,908 | 34,908 | 7,757 |
| **Other Assets** | | | |
| F) Pre-investment costs | 225 | 225 | 50 |
| G) Pre-production costs | 800 | 800 | 178 |
| H) Training costs | 350 | 350 | 78 |
| I) Interest during construction | 900 | 900 | 200 |
| Total other assets | 2,275 | 2,275 | 506 |
| Total Fixed Investment | 37,183 | 37,183 | 8,263 |
| Working Capital | 3,317 | 3,317 | 737 |
| Total Investment Cost | 40,500 | 40,500 | 9,000 |

YAR - Concrete Products Plant

Working Capital

The working capital estimate takes into account the long delivery periods for imported materials and the delays usually associated with the settlement of suppliers' accounts by government departments.

| | Year 0 (end of construction period) | | Year 4 (first year of full production) | |
|---|---|---|---|---|
| | | YR '000 | | |
| **Current Assets** | | | | |
| Cash, working balance | | 911 | | 198 |
| Accounts receivable. Two months' sales | | - | | 5,370 |
| Inventory | | | | |
| Raw materials. Local. Two weeks' supply. Imported steel and tar rope, 4 months | 1,606 | | 2,330 | |
| Spare parts (YR 1.4 million from year 1 onwards) | 1,000 | | 1,400 | |
| Concrete products while curing and in finished stock, 30 days | - | 2,606 | 3,200 | 6,930 |
| Total | | 3,517 | | 12,498 |
| **Current Liabilities** | | | | |
| Short-term debt (temporary borrowing needed at end of year 1) | | - | | - |
| Accounts payable. One month's credit for local purchases | | 200 | | 665 |
| Total | | 200 | | 665 |
| Working capital | | 3,317 | | 11,833 |
| US$ '000 equivalent | | 737 | | 2,630 |

YAR: CONCRETE PRODUCTS PLANT

ANNUAL OPERATING COSTS

A. Raw Materials, Electricity and Fuel (Year 4, at 100% Capacity Utilization)

Quantities

| | Unit | Pipe 1 | Pipe 2 | Poles | Cable Blocks | Pieces | Totals |
|---|---|---|---|---|---|---|---|
| Cement | Ton | 700 | 4,200 | 1,050 | 700 | 2,100 | 8,750 |
| Sand and Aggregates | $m^3$ | 2,600 | 15,600 | 3,900 | 2,600 | 7,800 | 32.500 |
| Reinforcing Steel 1/ | Ton | | 1,160 | 290 | | 50 | 1,500 |
| Tar Rope | m '000 | 25.7 | 34.3 | | | | 60.0 |
| Fuel 2/ | $m^3$ | 4.5 | 23.4 | 4.5 | 4.5 | 11.1 | 48.0 |
| Electricity | kWh | 192 | 941 | 192 | 173 | 422 | 1,920 |
| Gross Production | (Ton '000) | 5 | 30 | 7.5 | 5 | 15 | 62.5 |

Cost (YE '000)

| | | | | | | |
|---|---|---|---|---|---|---|
| Cement | 476 | 2,856 | 714 | 476 | 1,428 | 5,950 |
| Sand Aggregates | 260 | 1,560 | 390 | 260 | 780 | 3,250 |
| Reinforcing Steel | | 3,132 | 783 | | 135 | 4,050 |
| Tar Rope | 21 | 29 | | | | 50 |
| Total Raw Materials | 757 | 7,577 | 1,887 | 736 | 2,343 | 13,300 |
| Electricity | 192 | 941 | 192 | 173 | 422 | 1,920 |
| Fuel | 4 | 21 | 4 | 4 | 10 | 43 |
| Total Raw Materials, Electricity and Fuel | 953 | 8,539 | 2,083 | 913 | 2,775 | 15,263 |

1/ Reinforcing steel required per ton of large pipe and pole production is 40 kg, the requirement per ton of slabs, kerbs etc. is 10 kg.

2/ Electricity and fuel costs are allocated in proportion to fixed asset cost of respective product line, i.e. 10%, 49%, 10%, 9% and 22%.

B. Wages and Overhead (Year 4) (YR '000)

| | Pipe 1 | Pipe 2 | Poles | Cable Blocks | Pieces | Totals |
|---|---|---|---|---|---|---|
| Wages | 97 | 664 | 166 | 97 | 332 | 1,356 |
| Salaries | 79 | 475 | 119 | 79 | 238 | 990 |
| Administration, know-how, and contingencies | 156 | 764 | 156 | 140 | 343 | 1,559 |
| Maintenance and repair 1/ | 95 | 468 | 96 | 86 | 210 | 955 |
| Insurance 1/ | 92 | 455 | 93 | 83 | 204 | 927 |
| Sub-total | 519 | 2,826 | 630 | 485 | 1,327 | 5,787 |

C. Total Operating Costs (Year 4) (YR '000)

| | | | | | | |
|---|---|---|---|---|---|---|
| Raw Materials, electricity and fuel | 953 | 8,539 | 2,083 | 913 | 2,775 | 15,263 |
| Wages and Overhead | 519 | 2,826 | 630 | 485 | 1,327 | 5,787 |
| Total Operating Costs | 1,472 | 11,365 | 2,713 | 1,398 | 4,102 | 21,050 |
| Saleable Production Tons ('000) | 4.8 | 28.8 | 7.2 | 4.8 | 14.4 | 60.0 |
| | | | (Average cost per ton YR) | | | |
| Before depreciation, amortization and interest | 307 | 395 | 377 | 291 | 285 | 351 |

1/ Maintenance and repair, and insurance costs are allocated in proportion to fixed asset costs of respective product line.

D. Total Operating Cost from Year 1 Onwards (YR '000)

| | Year 1 | Year 2 | Year 3 | Years 4,5 | 6 Onwards |
|---|---|---|---|---|---|
| Raw Materials, Electricity and Fuel | 9,158 | 11,448 | 13,736 | 15,268 | 15,673 1/ |
| Wages and Salaries | 2,346 | 2,346 | 2,346 | 2,346 | 2,346 |
| Administration, Know-how, etc. | 1,040 | 1,235 | 1,430 | 1,559 | 1,559 |
| Maintenance and Repair | 573 | 716 | 860 | 955 | 1,055 2/ |
| Insurance | 927 | 927 | 927 | 927 | 927 |
| Total Operating Costs | 14,044 | 16,672 | 19,299 | 21,050 | 21,560 |
| Saleable Output (Tons) | 36,000 | 45,000 | 54,000 | 60,000 | 60,000 |
| Average Cost per Ton before Depreciation and Interest (YR) | 390 | 370 | 357 | 351 | 359 |

1/ Includes 10% import duty on steel and tar rope from year 6 onwards.

2/ Includes 10% import duty on spare parts from year 6 onwards.

# YAR: CONCRETE PRODUCTS PLANT

## ASSUMPTIONS TO THE FINANCIAL STATEMENTS

1. Capital costs are based on early 1981 prices plus 10% contingency allowance and 12.5% price escalation on the assumption that plant procurement, construction and commissioning would be undertaken over a 12 month period starting in 1981. Vehicles are replaced in years 6 and 12.

2. Prices of materials, spare parts and personnel are maintained at estimated 1981 levels. Manpower costs, which are subject to change, should be reviewed during planning and implementation.

3. Customs duties. As an important supplier of materials to government projects, the company is expected to be accorded exemption, under Law No. 12 of 1970, from customs duties on imported equipment and on raw materials during the first five years of operation. Thereafter duty of 10% is assumed for imported materials and vehicle replacements.

4. Sales are at constant prices averaging YR 542 (US$ 120.50 equivalent) per ton of concrete products. Prices take into consideration the prices now paid in the YAR for asbestos-cement pipes and European prices for other products as well as the need to obtain a reasonable profit margin.

5. Working capital. Current assets comprise: a reasonable working cash balance (normally not less than YR 100,000); 60 days' accounts receivable; two weeks supply of local raw materials and 4 months of imports; YR 1.4 million of spare parts from year 1 onwards (roughly 4% of total fixed assets installed); 30 working days of finished products undergoing curing and awaiting sale. Current liabilities: one month credit for local purchases. At the end of operating year one, an overdraft of YR 1.2 million is necessary to build up inventories; it is eliminated in the following year. Interest is calculated for six months at 15 per cent.

6. Nominal capacity of the five sections of the plant is 60,000 tons (24,000 cubic metres) of finished products on a single shift 300 working days a year. Input quantities allow for a loss of 4% in process and reject products. Output is at 60% of capacity in the first year of operation, 75% in year 2, 90% in year 3, and 100% from year 4 onwards.

7. Operating cash flow, shown in the Projected Income Statement (Annex 8), comprises sales revenue less operating costs before charging interest and depreciation. Sales and inputs are at constant 1981 prices.

8. The internal rate of return of 18.8% is derived by discounting the capital expenditure and the operating cash flow over 15 years (Annex 11).

9. Financial Plan. An equity : loan ratio of 40:60 is recommended for financing the YR 40.5 million investment in fixed and intangible assets and working capital:

| | | YR '000 | US$ '000 equivalent |
|---|---|---|---|
| Equity | 40% | 16,200 | 3,600 |
| Long term loans | 60% | 24,300 | 5,400 |
| Total Investment | 100% | 40,500 | 9,000 |

10. Loan Terms are consistent with foreign loans and suppliers credits available for industrial projects in the YAR today:

Interest: 10% p.a.
Grace Period: Two years after plant commissioning.
Repayment: Repayment of principal amortized over 8 years.

11. Depreciation of fixed assets is YR 3.15 million p.a., or 9% of initial fixed assets' value up to year 10, and YR 0.3 million p.a. thereafter.

12. Amortization of other intangible assets (including interest-during-construction) is YR 0.22 million p.a. over 10 years.

13. Corporate tax. As it is assumed the project will be an approved investment under Law No. 12 of 1970, the project is exempt from profits tax during the first 5 years of operation. Thereafter tax at 35% is deducted from annual profits after depreciation and amortization, payable in the following year.

14. Dividends. Annual profit available for dividends, at Annex 8 and 10, is the balance of profit after tax, allowing for a reasonable working cash balance (normally not less than ﷼ 100,000) and for the maintenance of shareholder's equity.

YAR: CONCRETE PRODUCTS PLANT

PROJECTED INCOME STATEMENT

(YR '000)

| | | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 1/ | Year 7 | Year 8 | Year 9 | Year 10 | Ys. 11 to 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Production, Capacity Utilization, % | | 60 | 75 | 90 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 2 | Production, Tons | | 36,000 | 45,000 | 54,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| 3 | Production Value | | 19,526 | 24,408 | 29,290 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 |
| 4 | Less: Increase in Finished Products | | 1,953 | 488 | 488 | 325 | | | | | | | |
| 5 | Sales Value | | 17,573 | 23,920 | 28,802 | 32,219 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 |
| 6 | Less: Increase in Accounts Receivable | | 2,962 | 1,026 | 812 | 570 | 54 | | | | | | |
| 7 | Sales Income | | 14,611 | 22,894 | 27,990 | 31,649 | 32,490 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 | 32,544 |
| 8 | Operating Costs | | 14,044 | 16,672 | 19,299 | 21,050 | 21,050 | 21,560 | 21,560 | 21,560 | 21,560 | 21,560 | 21,560 |
| 9 | Increase in Materials less increase in Accounts Payable | 2,406 | 171 | 313 | 180 | (59) | | 237 | | | | | |
| 10 | Operating Cash Flow (7-(8+9)) | | 396 | 5,909 | 8,511 | 10,658 | 11,440 | 10,747 | 10,984 | 10,984 | 10,984 | 10,984 | 10,984 |
| 11 | Profit before Depreciation and Tax (3-8) | | 5,482 | 7,736 | 9,991 | 11,494 | 11,494 | 10,984 | 10,984 | 10,984 | 10,984 | 10,984 | 10,984 |
| 12 | Less: Depreciation and Amortization | | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,445 | 300 |
| 13 | Interest | | 2,430 | 2,522 | 2,218 | 1,984 | 1,727 | 1,444 | 1,144 | 791 | 414 | | |
| 14 | Profit before Tax | | (318) | 1,844 | 4,403 | 6,140 | 6,397 | 6,170 | 6,481 | 6,823 | 7,200 | 7,539 | 10,684 |
| 15 | Less: Tax | | | | | | | 2,230 | 2,268 | 2,388 | 2,520 | 2,639 | 3,774 |
| 16 | Profit after Tax | | (318) | 1,844 | 4,403 | 6,140 | 6,397 | 3,940 | 4,213 | 4,435 | 4,680 | 4,900 | 6,910 |
| 17 | Undistributed Profit | | (318) | 1,844 | 403 | 140 | (603) | (1,060) | (87) | 335 | 640 | (1,294) | |
| 18 | Available for Dividends | | | | 4,000 | 6,000 | 7,000 | 5,000 | 4,300 | 4,100 | 4,040 | 6,194 | 6,910 |
| 19 | Available for Dividends, % of Share Capital | | | | 24.7 | 37.0 | 43.2 | 30.9 | 26.5 | 25.3 | 24.9 | 38.2 | 42.8 |

1/ Imported raw materials and spare parts subject to 10 per cent import duty from year 6 onwards.

Annex 8

YAR:CONCRETE PRODUCTS PLANT

PROJECTED BALANCE SHEETS

(YR '000)

| | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Year 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ASSETS** | | | | | | | | | | | | | | | | |
| **Current Assets** | | | | | | | | | | | | | | | | |
| Cash | 911 | 100 | 139 | 95 | 198 | 83 | 255 | 154 | 215 | 215 | 2,485 | 3,920 | 3,200 | 3,500 | 3,800 | 4,100 |
| Accounts Receivable | | 2,962 | 3,988 | 4,800 | 5,370 | 5,424 | 5,424 | 5,424 | 12,591 | 12,591 | 12,591 | 12,591 | 12,591 | 12,591 | 12,591 | 12,591 |
| Inventory | 2,606 | 4,960 | 5,849 | 6,605 | 6,930 | 6,930 | 7,167 | 7,167 | | | | | | | | |
| Total Current Assets | 3,517 | 8,022 | 9,976 | 11,500 | 12,498 | 12,437 | 12,846 | 12,745 | 12,806 | 12,806 | 15,076 | 16,511 | 15,791 | 16,091 | 16,391 | 16,691 |
| **Fixed Assets** | | | | | | | | | | | | | | | | |
| At Cost | 34,908 | 34,908 | 34,908 | 34,908 | 34,908 | 34,908 | 35,928 | 35,928 | 35,928 | 35,928 | 35,928 | 35,928 | 36,948 | 36,948 | 36,948 | 36,948 |
| Less: Accumulated Depreciation | | 3,150 | 6,300 | 9,450 | 12,600 | 15,750 | 18,900 | 22,050 | 25,200 | 28,350 | 31,500 | 31,800 | 32,100 | 32,400 | 32,700 | 33,000 |
| Net Fixed Assets | 34,908 | 31,758 | 28,608 | 25,458 | 22,308 | 19,158 | 17,028 | 13,878 | 10,728 | 7,578 | 4,428 | 4,128 | 4,848 | 4,548 | 4,248 | 3,948 |
| **Other Assets** | | | | | | | | | | | | | | | | |
| At Cost | 2,275 | 2,275 | 2,275 | 2,275 | 2,275 | 2,275 | 2,275 | 2,275 | 2,275 | 2,275 | 2,275 | | | | | |
| Less: Accumulated Amortization | | 220 | 440 | 660 | 880 | 1,100 | 1,320 | 1,540 | 1,760 | 1,980 | 2,275 | | | | | |
| Net Other Assets | 2,275 | 2,055 | 1,835 | 1,615 | 1,395 | 1,175 | 955 | 735 | 515 | 295 | - | | | | | |
| Total Assets | 40,700 | 41,835 | 40,419 | 38,573 | 36,201 | 32,770 | 30,829 | 27,358 | 24,049 | 20,679 | 19,504 | 20,639 | 20,639 | 20,639 | 20,639 | 20,639 |
| **LIABILITIES AND EQUITY** | | | | | | | | | | | | | | | | |
| **Current Liabilities** | | | | | | | | | | | | | | | | |
| Short-term Debt | | 1,223 | | | | | | | | | | | | | | |
| Accounts Payable | 200 | 430 | 518 | 606 | 665 | 665 | 665 | 665 | 665 | 665 | 665 | 665 | 665 | 665 | 665 | 665 |
| Current Maturities-Long-term Debt | | 2,125 | 2,337 | 2,571 | 2,828 | 3,111 | 3,422 | 3,764 | 4,412 | | | | | | | |
| Tax Payable | | | | | | | 2,230 | 2,268 | 2,388 | 2,520 | 2,639 | 3,774 | 3,774 | 3,774 | 3,774 | 3,774 |
| Total Current Liabilities | 200 | 3,778 | 2,855 | 3,177 | 3,493 | 3,776 | 6,317 | 6,697 | 7,195 | 3,185 | 3,304 | 4,439 | 4,439 | 4,439 | 4,439 | 4,439 |
| **Long-Term Debt** | | | | | | | | | | | | | | | | |
| Long-Term Loans | 24,300 | 24,300 | 22,175 | 19,838 | 17,267 | 14,439 | 11,328 | 7,906 | 4,142 | | | | | | | |
| Less: Current Maturities | | 2,125 | 2,337 | 2,571 | 2,828 | 3,111 | 3,422 | 3,764 | 4,142 | | | | | | | |
| Net Long-Term Debt | 24,300 | 22,175 | 19,838 | 17,267 | 14,439 | 11,328 | 7,906 | 4,142 | - | | | | | | | |
| **Shareholders' Equity** | | | | | | | | | | | | | | | | |
| Share Capital | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 |
| Retained Earnings | | (318) | 1,526 | 1,929 | 2,069 | 1,466 | 406 | 319 | 654 | 1,294 | | | | | | |
| Shareholders' Equity | 16,200 | 15,882 | 17,726 | 18,129 | 18,269 | 17,666 | 16,606 | 16,519 | 16,854 | 17,494 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 |
| Total Liabilities and Equity | 40,700 | 41,835 | 40,419 | 38,573 | 36,201 | 32,770 | 30,829 | 27,358 | 24,049 | 20,679 | 19,504 | 20,639 | 20,639 | 20,639 | 20,639 | 20,639 |

Annex 9

YAR: CONCRETE PRODUCTS PLANT

PROJECTED STATEMENT OF SOURCE AND APPLICATION OF FUNDS

(YR '000)

| | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 1/ | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 1/ | Year 13 to 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FUNDS PROVIDED | | | | | | | | | | | | | | |
| Shareholders' Equity | 16,200 | | | | | | | | | | | | | |
| Long-Term Loans | 24,300 | | | | | | | | | | | | | |
| From Operations | | | | | | | | | | | | | | |
| Net Income | | (318) | 1,844 | 4,403 | 6,140 | 6,397 | 3,940 | 4,213 | 4,435 | 4,680 | 4,900 | 6,910 | 6,910 | 6,910 |
| Depreciation, Amortisation | | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 | 3,445 | 300 | 300 | 300 |
| Total from Operations | | 3,052 | 5,214 | 7,773 | 9,510 | 9,767 | 7,310 | 7,583 | 7,805 | 8,050 | 8,345 | 7,210 | 7,210 | 7,210 |
| Total Funds Provided | 40,500 | 3,052 | 5,214 | 7,773 | 9,510 | 9,767 | 7,310 | 7,583 | 7,805 | 8,050 | 8,345 | 7,210 | 7,210 | 7,210 |
| FUNDS APPLIED | | | | | | | | | | | | | | |
| Fixed Assets | 34,908 | | | | | | 1,020 | | | | | | 1,020 | |
| Other Assets | 2,275 | | | | | | | | | | | | | |
| Repayment of Long-Term Debt | | | 2,125 | 2,337 | 2,571 | 2,828 | 3,111 | 3,422 | 3,764 | 4,142 | | | | |
| Working Capital | | | | | | | | | | | | | | |
| Cash | 911 | (811) | 39 | (44) | 103 | (115) | 172 | (101) | 61 | | 2,270 | 1,435 | (720) | 300 |
| Accounts Receivable | | 2,962 | 1,026 | 812 | 570 | 54 | | | | | | | | |
| Inventories | 2,606 | 2,354 | 889 | 756 | 325 | | 237 | | | | | | | |
| Short-Term Debt | | (1,223) | 1,223 | | | | | | | | | | | |
| Accounts Payable | (200) | (230) | (88) | (88) | (59) | | | | | | | | | |
| Tax Reserve | | | | | | | (2,230) | (38) | (120) | (132) | (119) | (1,135) | | |
| Total Working Capital | 3,317 | 3,052 | 3,089 | 1,436 | 939 | (61) | (1,821) | (139) | (59) | (132) | 2,151 | 300 | (720) | 300 |
| Available for Dividends | | | | 4,000 | 6,000 | 7,000 | 5,000 | 4,300 | 4,100 | 4,040 | 6,194 | 6,910 | 6,910 | 6,910 |
| Total Funds Applied | 40,500 | 3,052 | 5,214 | 7,773 | 9,510 | 9,767 | 7,310 | 7,583 | 7,805 | 8,050 | 8,345 | 7,210 | 7,210 | 7,210 |

1/ Vehicles replaced in years 6 and 12. Cost includes 10 per cent import duty.

YAR - Concrete Products Plant

Internal Rate of Return (YR '000)

| Year | Capital Expenditure | Operating Cash Flow [1] |
|---|---|---|
| 0 | 40,500 | |
| 1 | | 396 |
| 2 | | 5,909 |
| 3 | | 8,511 |
| 4 | | 10,658 |
| 5 | | 11,440 |
| 6 | 1,020 [2] | 10,747 |
| 7 | | 10,984 |
| 8 | | 10,984 |
| 9 | | 10,984 |
| 10 | | 10,984 |
| 11 | | 10,984 |
| 12 | 1,020 [2] | 10,984 |
| 13 | | 10,984 |
| 14 | | 10,984 |
| 15 | | 10,984 |
| | | 146,517 |
| 16 | | 16,200 [3] |
| Total | 42,540 | 162,717 |

| Discounted at | Net Present Value over 15 Years of Operation |
|---|---|
| 5% | 62,691 |
| 10% | 29,919 |
| 15% | 10,095 |
| 18% | 1,875 |
| 18.8% | 15 |
| 20% | -2,256 |
| 25% | -11,022 |

Internal rate of return: 18.8%

---

1/ Sales income less inventory increase less operating costs (Annex 8).

2/ Vehicle replacements include 10% import duty.

3/ Residual value of assets in year 16.

## YAR - Concrete Products Plant

## Sensitivity Analysis

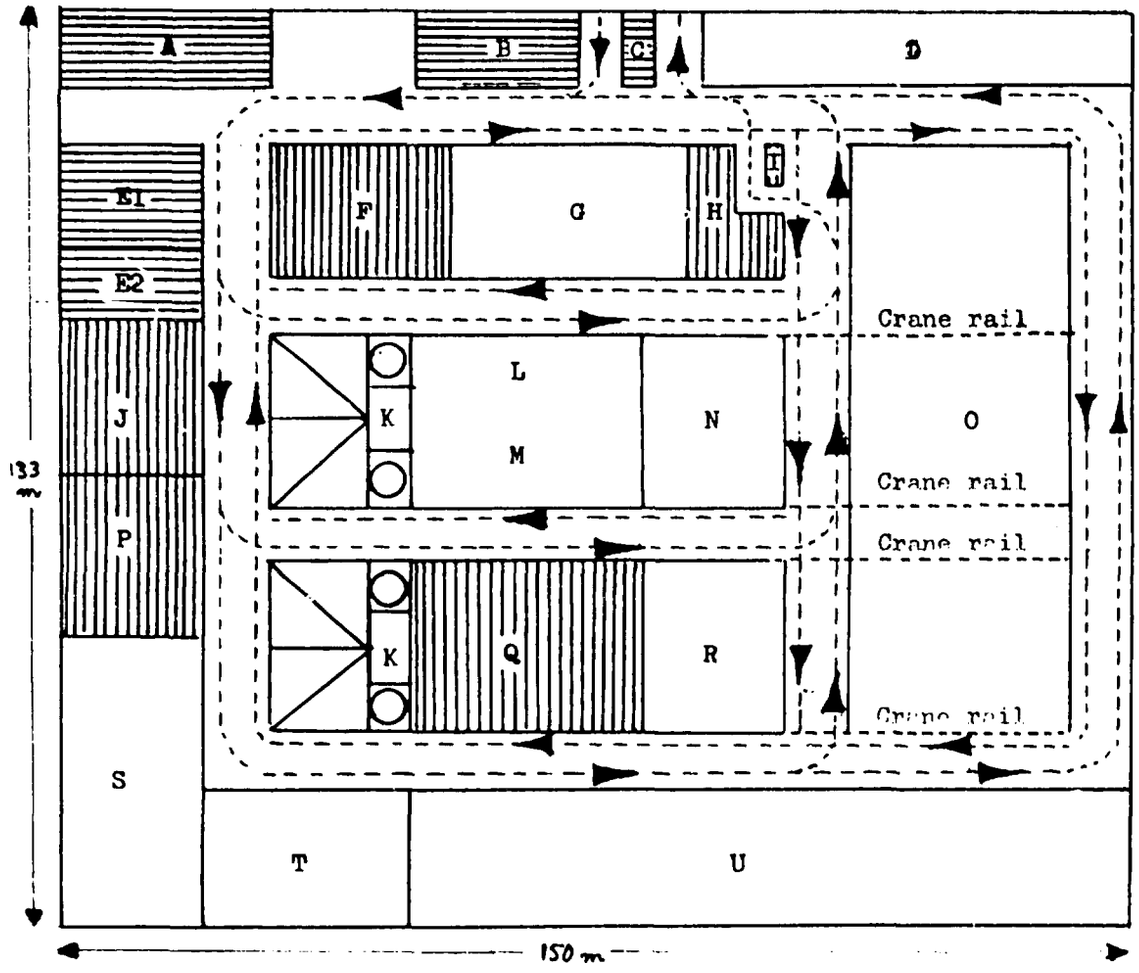
The discounted rate of return is based on (a) a capital investment of YR 40,500,000 during the one year construction period and YR 1,020,000 in years 6 and 12 for replacement of vehicles, (b) operating cash flows over 15 years, and (c) a residual asset value of YR 16,200,000 in year 16 (Annex 11).

### Internal Rate of Return

| | |
|---|---|
| **Base case** | **18.8%** |
| At: | |
| Capital expenditure plus 10% | 17.1% |
| plus 20% | 15.6% |
| plus 50% | 12.1% |
| Operating cash flow delayed by one year | 15.9% |
| Sales price plus 10% | 24.4% |
| minus 10% | 12.5% |
| Raw materials prices plus 10% | 16.2% |
| minus 10% | 21.4% |
| Electricity price minus 50% | 20.4% |
| Wages and salaries plus 10% | 18.3% |
| plus 50% | 16.2% |
| Production and sales lower by 10% | 15.7% |
| lower by 20% | 12.3% |
| Production and sales at 60% of nominal capacity in year 1, 75% in year 2 and 90% from year 3 onwards | 17.2% |
| Production and sales at 60% in year 1 and 75% thereafter | 12.5% |
| Production and sales of large diameter pipe at 50% of plan; other lines unchanged | 9.0% |
| Base case with operating cash flow discounted over 10 instead of 15 years | 16.6% |

# YAR: CONCRETE PRODUCTS PLANT

## PRELIMINARY LAYOUT




A – Personnel & Services Building
B – Office Building
C – Watchman's House
D – Products Display Area
E1 – Warehouse
E2 – Workshop
F – Reinforcements Plant
G – Steel Storing Area
H – Garage & Vehicle Repair Shop
I – Diesel Pump
J – Storing Area
K – Concrete Mixing Plant
L – Small Production Line
M – Large Production Line
N – Crane
O – Finished Products Yard
P – Storing Area
Q – Poles, Cable Blocks & Slabs Production
R – Crane
S – Sand Washing Plant
T – Mud and Solid Waste Area
U – Finished Products Yard

Concrete Buildings

Concrete Paved & Steel Roofed Areas

Cement Silos

Source: Günter Appel, Consultant

ANNEX 13