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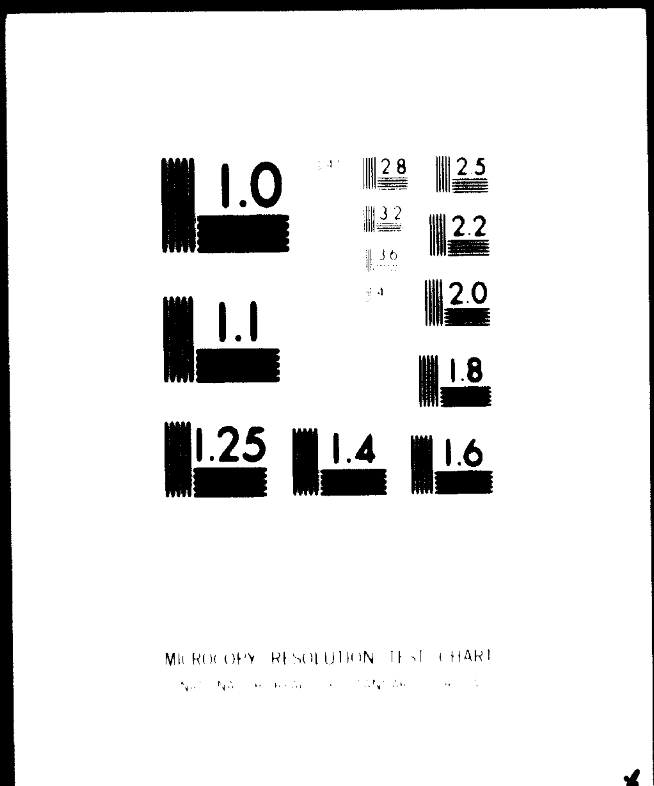

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EXPLANATION OF SYMBOLS

Three dots (...) indicate that data are not available or are not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank space ( ) in a table means that the item is not applicable.

A plus sign (+) indicates a surplus or an increase.

A minus sign (-) indicates a deficit or decrease.

A space between numerals is used to distinguish thousands and millions (1 346 849).

A full stop (.) is used to indicate decimals.

A stroke (/) indicates a crop year or fiscal years, e.g. 1953/1954

Use of a hyphen (-) between dates representing years, e.g. 1960-64 normally signifies an annual average for the calendar years involved, including the beginning and end years. 'To' between the years indicates the full period, e.g. 1960 to 1964 means 1960 to 1964, inclusive.

Reference to 'tons' indicates metric tons, and to 'dollars' United States dollars, unless otherwise stated.

Details and percentages in tables do not necessarily add up to totals, because of rounding.

6 - STEEL DEMAND ANALYSIS

As discussed in Chapter 4 the technique employed for estimating the present and future requirement of tonnage and alloy steels by the various consuming sectors is the 'end-use method'. In order to check the validity of the estimates made, other demand forecasting techniques (such as regression, graphical extrapolation and time-trend techniques) have been employed.

Determination of future output levels

Stage of industrial development

With the Fourth Plan, Iran has commenced her long term programme of rapid industrialisation. A number of industries consuming tonnage and alloy steels, are in different stages of development. These steel-consuming industries may be broadly grouped into

i) existing industries;

ii) industries under implementation and/or active consideration; and

iii) industries in the planning stage.

Collation of data

For estimating the output levels of existing industries, field survey data were mainly utilised. As the information furnished by consumers provided the guide lines, the validity of the assessment is to a large extent dependent on the accuracy with which this group of consumers were able to visualise their future production programmes. The information has, therefore, been suitably adjusted to allow for possible over or under estimation.

Projections up to 1982

While user industries were fairly sure of their anticipated output levels up to 1972, they could only broadly indicate their production plans by 1977, and beyond this date they could give no indications at all. Therefore, the projections for steel consuming items up to 1982 had to be made generally on the basis of growth rates calculated from the trends up to 1977. However, it is expected that some user industries may not maintain an accelerated growth rate after reaching a certain level of production. In such cases adjustments were made for the possible 'flattening off' of the growth rates of those industries, after the initial period of accelerated growth.

Plan programmes and output levels

For estimating the future output levels of those steel consuming items production of which is now under implementation or active consideration, the Plan programmes of production and targets of output were taken into account. Where only the capacities to be installed are known, the possibility of lower production levels in the initial stages due to teething troubles and lower operational efficiency was given consideration. Anticipated output levels could thus be obtained generally only up to 1977, and for 1982 these had to be projected on the basis of calculated growth rates.

Projection from imports

The forecasts of output of certain products, plans for the manufacture of which are in the proposal stage, or which are to be taken up for manufacture by 1982, were made on the basis of past consumption, represented mainly by imports. The past import figures over a period of time were analysed and extended up to 1982 and the average use in imports was taken as indicative of the growth rates postulated for the respective products. For example, imports of radio receivers during the period 1962 to 1968 were analysed, and an increase of 15 per cent per year was taken up to 1972, followed by 10 per cent per year in the subsequent ten years for the possible 'tapering off' of the growth.

The basis of the forecasts for all consuming items is discussed in Appendix 6-1.

6 - Steel demand analysis (cont'd)

Constructional and allied activities in different economic sectors

Projections of constructional and allied activities

Eleven major economic sectors have been studied for determining the steel demand arising from construction and allied activities. The likely investment in 1972 has been assumed as one-fifth of the total Fourth Plan (1967 - 1972) investment target covering nine sectors. For forecasting investment levels in 1977 and 1982, growth rates of the related economic indicators were determined from various discussions held with relevant authorities and investment levels planned during the Fourth Plan. The indicated growth rates of these economic indicators were also cross checked with the derived growth rates from the past data (Appendix 6-2 and shown in Fig. 6-1). Based on these two estimates growth rates were assumed. It may be mentioned that in the Draft Report submitted by the Consultant, slightly lower growth rates had been taken initially. In discussions with the Ministry of Economy and Research Center personnel in September 1970 it was agreed that the growth rates stated below be taken, as they better represented the present plans. These growth rates were suitably adjusted downwards to allow for the fact that the high growth rates feasible during the Fourth Plan (which started from a comparatively low base) cannot be maintained during the Fifth Plan (1972 - 1977) and Sixth Plan (1977 - 1982) periods, which will start with much higher bases.

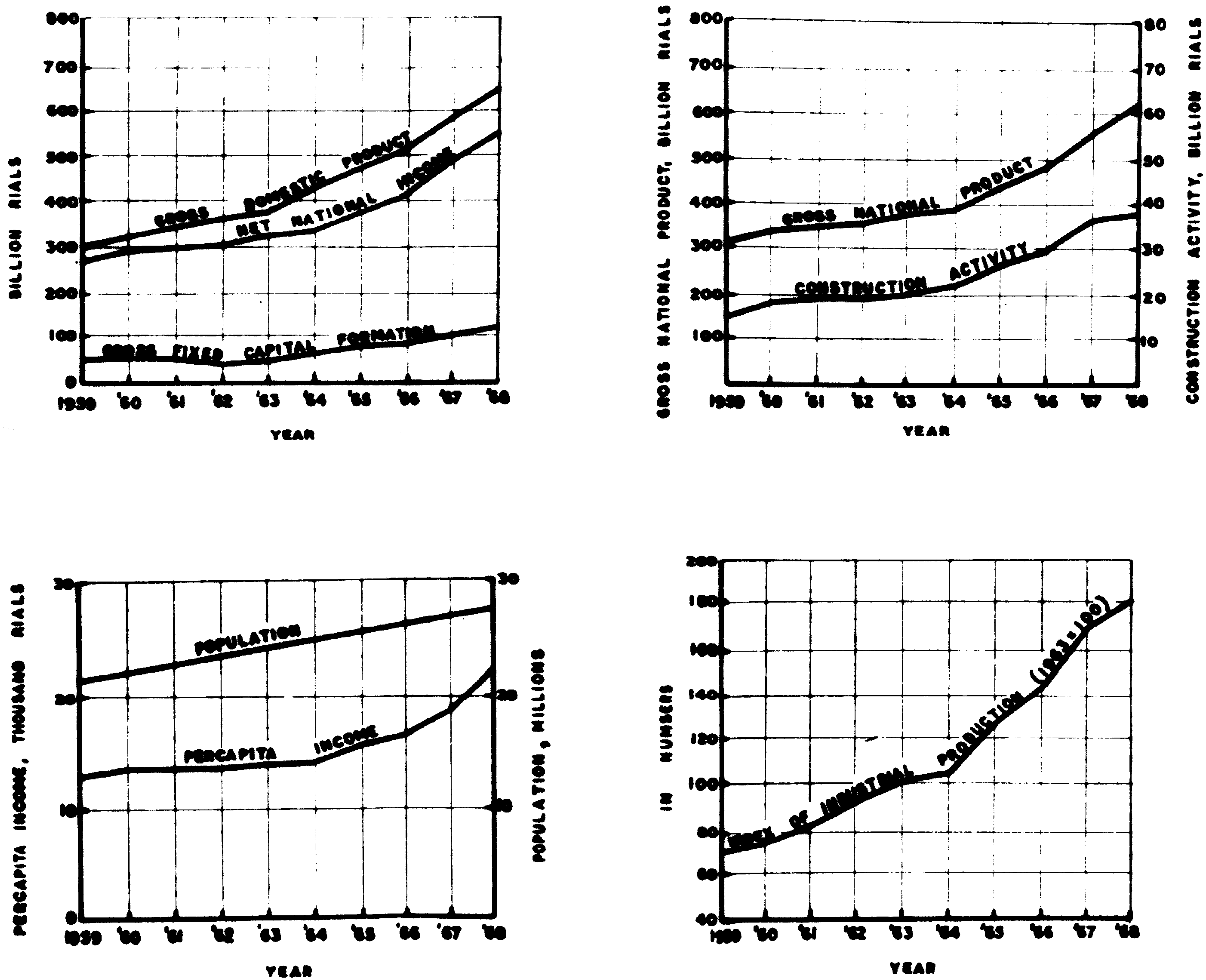

FIG.6-1. BASIC ECONOMIC INDICATORS OF IRAN

6 - Steel demand analysis

The related economic indicators and the growth rates assumed are given below for nine out of the eleven sectors considered.

	Item	Economic indicator	Growth rate % 1967 to 1972	1972 to 1977	1977 to 1982
1.	Large and medium industries	Index of industrial production	13.0	12.0	11.0
2.	Agricultural and allied activities	National income	9.5	8.5	7.5
3.	Oil and gas	Index of industrial production	13.0	12.0	11.0
4.	Irrigation	National income	9.5	8.5	7.5
5.	Roads and bridges	Index of industrial production	13.0	12.0	11.0
6.	Social services	National income	9.5	8.5	7.5
7.	Telecommunication	National income	9.5	8.5	7.5
8.	Airports	National income	9.5	8.5	7.5
9.	Ports and harbours	National income	9.5	8.5	7.5

The details of the development programmes for the remaining two sectors, namely power supply and rail transport, are given in Appendix 6-3 and 6-4 and summarised in Table 6-1.

6 - Steel demand analysis (cont'd)

Table 6-1

POWER SUPPLY AND RAIL TRANSPORT PROGRAMME

	Unit	1972	1977	1982
Power supply				
Generation	MW	350	385	545
Transmission	km	630	700	1 080
Distribution	Million Rials of total outlay	765	1 110	1 610
Rail transport				
New track	km	350	300	600
Track renewals	km	136	136	136
Electrification	km	-	150	300
Maintenance (wagons only)	no	2 800	3 000	4 400
Signalling and safetyworks	km	350	300	600

Tonnage and alloy steel requirements

Norms of consumption

The steel consumption norms per unit of output have been determined by the following methods:

a) on the basis of field survey.

Production of steel consuming items and steel consumption by categories per unit output of product were collected from the manufacturing plants. The weighted average consumptions per unit of production have been taken as the norms of consumption. Separate norms were evolved for relevant manufactured items to take care of possible diversification of production programme, technological changes and structural changes in the economy.

6 - Steel demand analysis (cont'd)

(b) on the basis of practices followed in similar economies.

For those items where requisite data could not be obtained from the manufacturing units and also for items which are not under production but are likely to be manufactured in future, norms were evolved on the basis of norms of consumption for like items obtaining in countries with similar level of economic development.

The methods by which norms were determined are discussed in Appendices 6-5 and 6-6 and the actual norms are given in Appendices 6-7 and 6-8.

Non-coverage

Output levels adjusted for non-coverage

The output levels estimated for various items in 1972, 1977 and 1982 need some adjustment for possible non-coverage during field survey. As relevant production statistics for all manufactured items for years subsequent to 1965 were not available, the extent of non-coverage was determined on the basis of actual production figures for 1965 issued by the Ministry of Economy and compared with field survey production data for the same year. The non-coverage ascertained on this basis is given in Table 6-2. Obviously, for items which are not under production, non-coverage does not arise.

6 - Steel demand analysis (cont'd)

Table 6-2

NON-COVERAGE FOR 1965 PRODUCTION

Item	Unit	Field survey data	Actual production figures	Percent non-coverage
A. Transport equipment				
Buses and mini-buses	no	1 382	1 382	nil
Cars	no	2 756	2 756	"
Trucks	no	1 750	1 750	"
Jeep, station-wagon ambulances and van etc	no	-	-	"
Auto leaf spring	tons	3 000	3 000	"
Bicycles complete	no	46 000	48 673	5.50
B. Electrical equipment				
Electric transformer	KVA	2 000	2 000	nil
Air coolers	no	8 000	9 035	11.00
Refrigerators	no	35 000	38 927	10.00
Water coolers	no	2 400	2 500	4.00
Water heaters	no	50 000	52 000	3.85
Television sets	no	16 000	17 405	8.50
C. Industrial and agricultural machinery				
Tea processing machinery	million Rials	40.5	50.5	21.00
D. Metal products				
Steel furniture	tons	13 000	15 000	13.30
Builders hardware	tons	2 300	3 000	23.00
Tanks	tons	3 200	3 725	16.00
Gas cylinders	no	150 000	150 000	nil
Stoves	no	12 000	15 000	25.00
Steel drums and containers	tons	8 000	8 000	nil
Arc welding electrodes	tons	2 600	2 671	2.70
Windows and door frames	tons	35 000	37 932	8.50

REPORT

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ON

ASSESSMENT OF STEEL DEMAND IN IRAN

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VOLUME III

DECEMBER 1970

M. N. DASTUR & COMPANY PRIVATE LTD, CALCUTTA
DASTUR ENGINEERING INTERNATIONAL GmbH, DUSSELDORF
Consulting Engineers

The projected output levels of various steel consuming items, suitably adjusted for non-coverage, are given in Appendix 6-9.

Sectoral and categorywise tonnage steel demand

By applying the norms of consumption to the output levels, the demand for tonnage steels broken down into product categories has been estimated separately for the years 1972, 1977 and 1982. Details are given in Appendices 6-10, 6-11 and 6-12.

Spares and maintenance

Iran being in the initial phase of rapid industrialisation, it is likely that steel requirement for spares and maintenance will be somewhat higher than in developed countries. Provision for this has been taken as 10 per cent of the total steel required for manufacturing.

Defence

As no information is available, the steel requirements for defence purposes have been excluded from the forecasts. These requirements could well constitute about 10% of the other requirements, and would obviously have priority.

Small & medium scale industry

Data on small scale units lacking

Besides the organised industrial units in the public and private sectors, there are many small units engaged in the production and servicing of metal products such as consumer durables, domestic appliances, agricultural implements etc. These small scale industrial units are concentrated in and around Teheran. Detailed information on the number of such units or their output, investment, number of employees etc is lacking.

Information being compiled

The Ministry of Economy has recently set up an organisation for Small Scale Industries and Industrial Estates of Iran for the proper planning and development of private units in this sector of industry. This organisation is now compiling information on small scale industrial units and also planning to set up industrial estates in different industrial centres such as Ahwas, Arak and Tabris.

"Small scale" defined

According to regulations formulated by the above organisation any industry to qualify as a small scale industry must fulfil the following requirements:

1. Ownership and management of the industry must be 100% Iranian

2. Fixed assets at the time of occupancy of a factory must not exceed 5 million Rials. For this purpose, the fixed assets comprise the total capital investment in the workshop or factory, on the condition that the investment in buildings and land do not exceed one-fourth of the total capital.

3. Maximum number of employees should not exceed 50 per shift.

4. The industry must not be of an artistic nature.

5. Management must not be divided on the basis of speciality.

Handicrafts

Besides the small scale industries, there are handicraft and cottage industries which may be omitted from the study as their requirements of steel by way of tools and equipment are adequately covered under tool and equipment manufacture.

Steel requirement of small scale industries

The steel requirements of small & medium scale industries have been covered only to a limited extent by manufactured items included under the various heads discussed above. Estimating the steel requirement of a large number of diverse small scale manufacturing and servicing units presents a difficult problem due to non-availability of relevant data. It is claimed that at present there are as many as 2,000 units engaged in production of different metal products and construction items, and such units are likely to multiply rapidly in future. On the basis of the meagre information available, and the non-coverage arrived at in 1968 (vide chapter 4), it is assumed that steel requirements for small and medium scale industries will be of the order of 4, 6 and 10 per cent of the total in 1972, 1977 and 1982 as it is likely that with more and more industrialisation, the number and field of small and medium scale industires will be more to cater to the demand of various diversified product in future.

__Allowance for stocks__

Large stocks maintained __at present__

Iran has been hitherto depending solely on imported steel. Manufacturers and fabricators have had to maintain large inventories of steel, even up to six months requirements, due to long procedural delays and uncertainties associated with imports from the world market.

consuming __centres__

In an extensive country with a few big and several small steel consuming centres spread over the country, only a few entry ports and limited transport facilities, building up of stocks at consuming centres assumes considerable significance. This is reflected in the fact that steel is cheaper in Teheran (where there is heavy concentration of steel consuming industries as well as of the steel trade) than in any other place in the country.

Indigenous production and __distribution__

With greater availability of steel from indigenous production, steel inventories maintained by end users would decline. The sharp rise in steel consumption from the current level of about one million tons to over three million tons in the late seventies, simultaneously with each consumer trying to reduce his inventory, would call for more rapid turn over in the trade through stockists, distributors and warehouses at various centres in the country. The manufacturers themselves would have to maintain adequate stocks to be able to meet promptly small orders in a wide range of product categories and sizes. Moreover, there is need for build up of buffer stocks to tide over periods of peak demand.

Provision for stocks

Steel going into stocks is not accounted for anywhere and, therefore, separate provision needs to made for this in the demand forecast. With increasing indigenous production and ready availability of steel, stocks equivalent to two months consumption would be adequate. As there will be carry over of the stocks from year to year, the increased production necessary to maintain the stocks at one-sixth of consumption level is only one-sixth of the estimated growth rate of steel demand, that is about 1.5 per cent.

Steel requirement for spares and maintenance, small scale industries and stocks summarised in Table 6-3.

Growth rate of steel demand

Table 6-3 indicates growth rates in steel demand of 9.1 per cent between the period 1972 - 1977 and 11.1 per cent between the period 1977 - 1982, which are to be expected in a rapidly industrialising country.

6 - Steel demand analysis (cont'd)

Table 6-3

DEMAND FOR STEEL (EXCLUDING DEFENCE & EXPORT)
(all figures in tons)

	1972	1977	1982
Steel for manufacturing sectors (A + B + C + D)	761 750	1 242 783	2 174 455
Constructional and allied activities (E)	703 009	956 066	1 382 941
Sub-total	1 464 759	2 198 849	3 557 396
Spares and maintenance at 10% of total steel required for manufacturing	76 800	124 300	217 500
Small and medium scale industries a/	57 772	141 122	371 492
Stock at 1.5% of total steel	22 000	38 000	58 000
Sub-total	158 972	303 422	646 992
Total finished steel	1 620 731	2 502 271	4 204 388
Say	1 621 000	2 502 000	4 204 000
Total liquid steel @ 80% yield	2 026 000	3 128 000	5 250 000

a/ 4, 6 and 10 per cent have been provided for 1972, 1977 and 1982 respectively.

Overall requirement of steel

Taking into consideration requirements for spares, maintenance and stocks, the total requirements of steel by product categories along with percentage composition are given in Table 6-4.

6 - Steel demand analysis (cont'd)

Table 6-4

TOTAL REQUIREMENT OF STEEL BY PRODUCT CATEGORIES a/

Product category	1972 Tons	1972 %	1977 Tons	1977 %	1982 Tons	1982 %
Structurals						
Beams	252 605	15.57	257 948	10.29	210 376	5.00
Channels	55 961	3.44	82 267	3.28	117 540	2.82
Angles	79 036	4.91	127 254	5.08	238 206	5.67
Tees	4 029	0.25	6 778	0.30	13 126	0.30
Sub-total	391 631	24.17	474 247	18.95	579.248	13.79
Flat products						
Plates	171 970	10.62	282 896	11.31	495 849	11.80
CR sheets/strips	225 992	13.93	451 224	18.03	831 883	19.78
HR sheets/strips	232 379	14.35	365 078	14.62	687 778	16.38
Tinplates	54 193	3.33	66 852	2.66	82 790	1.97
Galvanised sheets	59 006	3.62	96 516	3.84	155 665	3.74
Sub-total b/	743 540	45.85	1 262 566	50.46	2 254 965	53.67
Others						
Bars and rods	200 744	12.39	397 656	15.90	717 225	17.00
Wires	12 545	0.83	22 376	0.89	50 664	1.25
Pipes and tubes c/	53 202	3.30	97 281	3.86	163 226	3.85
Sub-total	266 491	16.52	517 313	20.65	931 115	22.10
Semis d/	138 600	8.51	176 250	7.04	315 900	7.51
Railway materials						
Rails	41 036	2.52	36 723	1.48	62 780	1.49
Railway materials	39 433	2.43	35 271	1.42	60 380	1.44
Sub-total	80 469	4.95	71 994	2.90	123 160	2.93
Total	1 620 731	100.00	2 502 371	100.00	4 204 388	100.00
Rounded off	1 621 000		2 502 000		4 204 000	

a/ Excluding defence, substitution and export requirements

b/ Includes 80,000 tons of plates and 172,000 tons of hot rolled sheets/strips in 1972, 110,000 tons of plates and 255,000 tons of hot rolled sheets/strips in 1977 and 204,000 tons of plates and 469,000 tons of hot rolled sheets/strips in 1982, required for the manufacture of pipes and tubes for oil, gas and water considered as a separate item under metal products. This excludes pipes and tubes required for as part of other manufactured items which is given in the above table (see note c/ below)

c/ Pipes and tubes as part of manufactured items calculated on the basis of norms of consumption

d/ Semis for seamless tubes required for gas, oil and other uses.

6 - Steel demand analysis (cont'd)

The demand of tonnage steel by product categories and total tonnage steel demand are shown in Figs. 6-2, 6-3, 6-4, 6-5 and 6-6.

Demand trend: structural products: <u>Fig. 6-2</u>

It will be observed from the demand trend for different structural products shown in Fig. 6-2 that the demand for beams will go down, while the demand for channels, angles and tees will go up. The decrease in the overall requirement of beams is due to structural changes in consumption norms for building construction. It is anticipated that in future years more and more r.c. construction will be adopted for buildings instead of structural steel frame construction.

Demand trend: Flat products: <u>Fig. 6-3</u>

The trend of demand for flat products is shown in Fig. 6-3. It is to be noted that significant tonnages of hot rolled sheets and plates required for conversion into pipes and tubes have also been included under this category.

Demand trend: Other products <u>Fig. 6-4</u>

The demand for bars, rods and wires is shown in Fig. 6-4. The consumption of bars and rods is likely to go up rapidly as the mode of construction of building is changing from structural steel frame to r.c. construction.

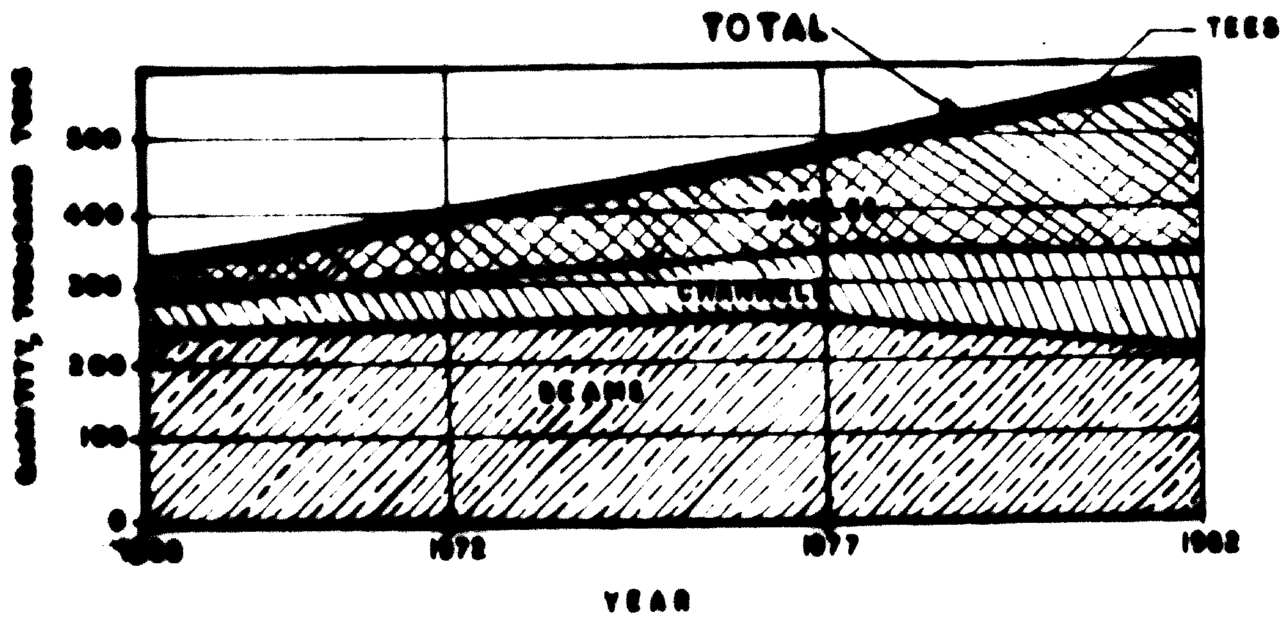

FIG. 6-2: DEMAND FOR STRUCTURALS

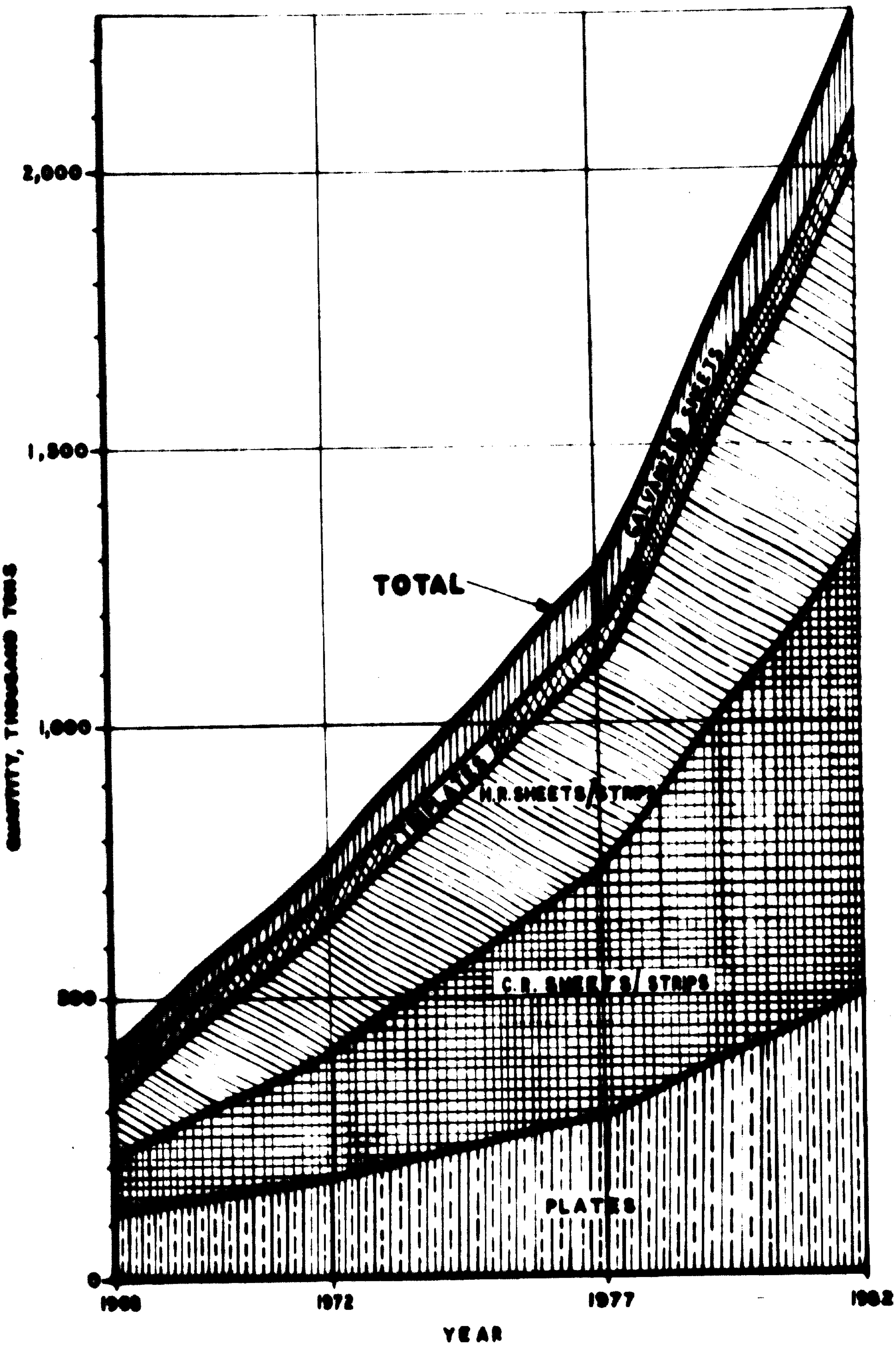

FIG. 6-3: DEMAND FOR FLAT PRODUCTS

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REPORT

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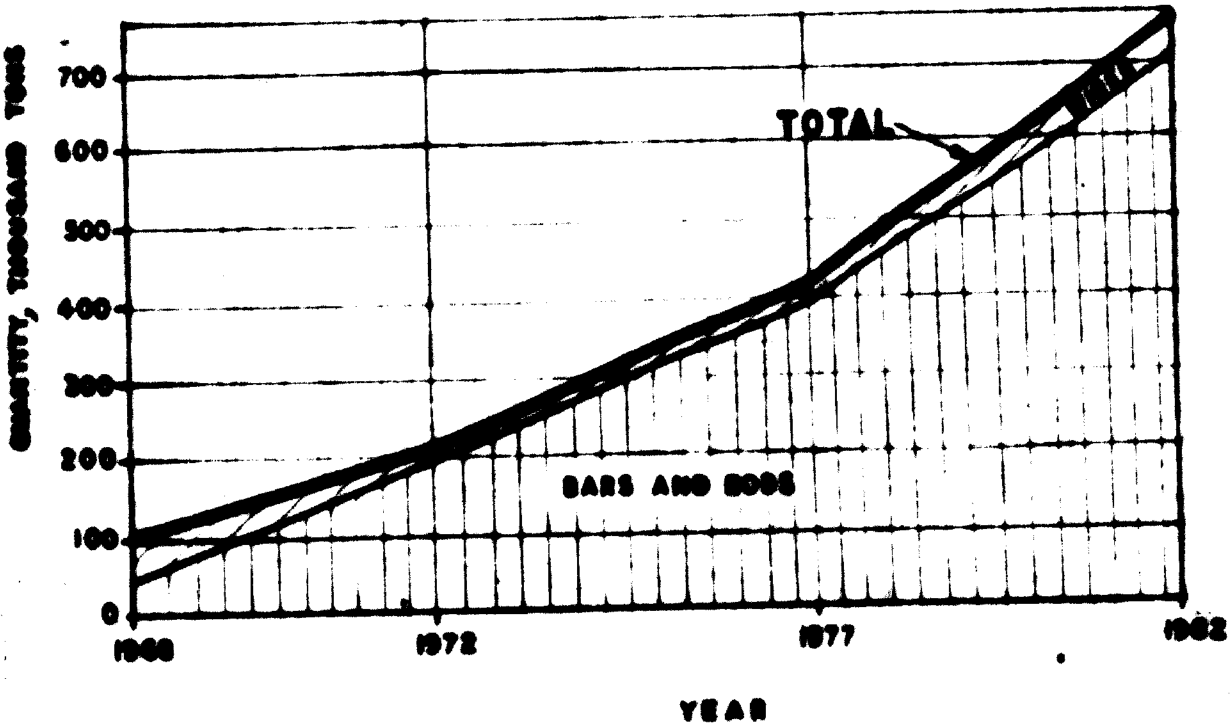

FIG. 6-4: DEMAND FOR OTHER PRODUCTS (EXCLUDING PIPES AND TUBES)

6 - Steel demand analysis (cont'd)

Demand trends railway materials <u>Fig. 6-5</u>

The demand for railway materials (rails and other railway materials) shown in Fig. 6-5 indicates a drop in 1977. This drop is due to less route-km of railway lines proposed to be laid during this period than in 1972 and 1982.

Categorywise and aggregate demand <u>Fig. 6-6</u>

The demand for tonnage steel by principal categories and the aggregate demand are shown in Fig. 6-6. It is to be noted that in terms of actual tonnage the increase in the demand for flat products is much greater than the increase in the demand for semis, railway materials and others (bars, rods, wires, pipes and tubes). The demand of structurals has risen only by 105,000 tons during the five year period of 1977 to 1982. The reason for the large increase in demand for flat products is the rapid growth anticipated in automobile, railway rolling stock and household appliances industries, which are the principal consumers of flat products. Moreover, the production of pipes for which plates, sheets/skelp will be required is also expected to increase substantially. In the case of structurals the effect of substitution of steel structurals for construction purposes by r.c. is the reason for the low rise in demand though investment in constructional activities will increase progressively from 1972 through 1977 to 1982.

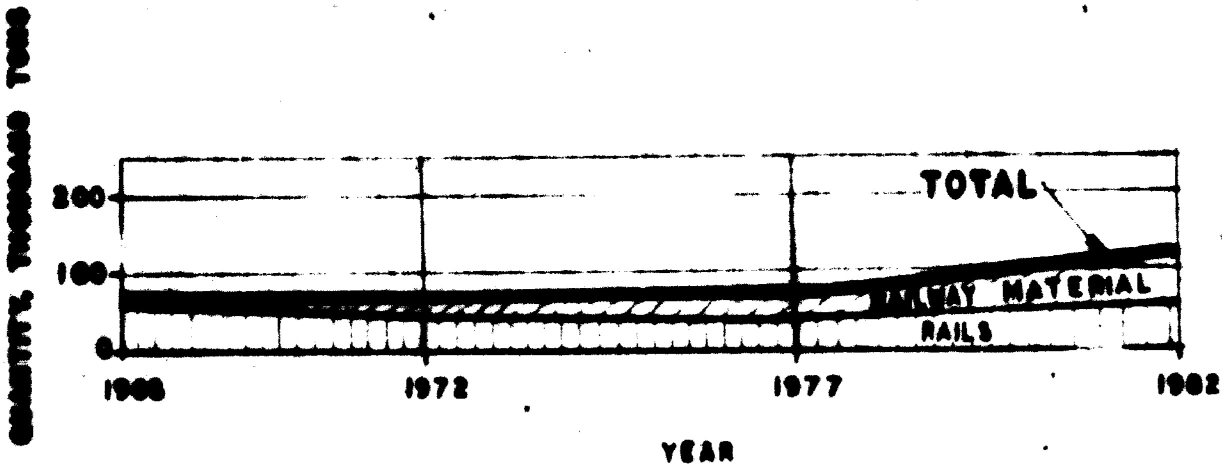

FIG. 6 – 3: DEMAND FOR RAILWAY MATERIALS

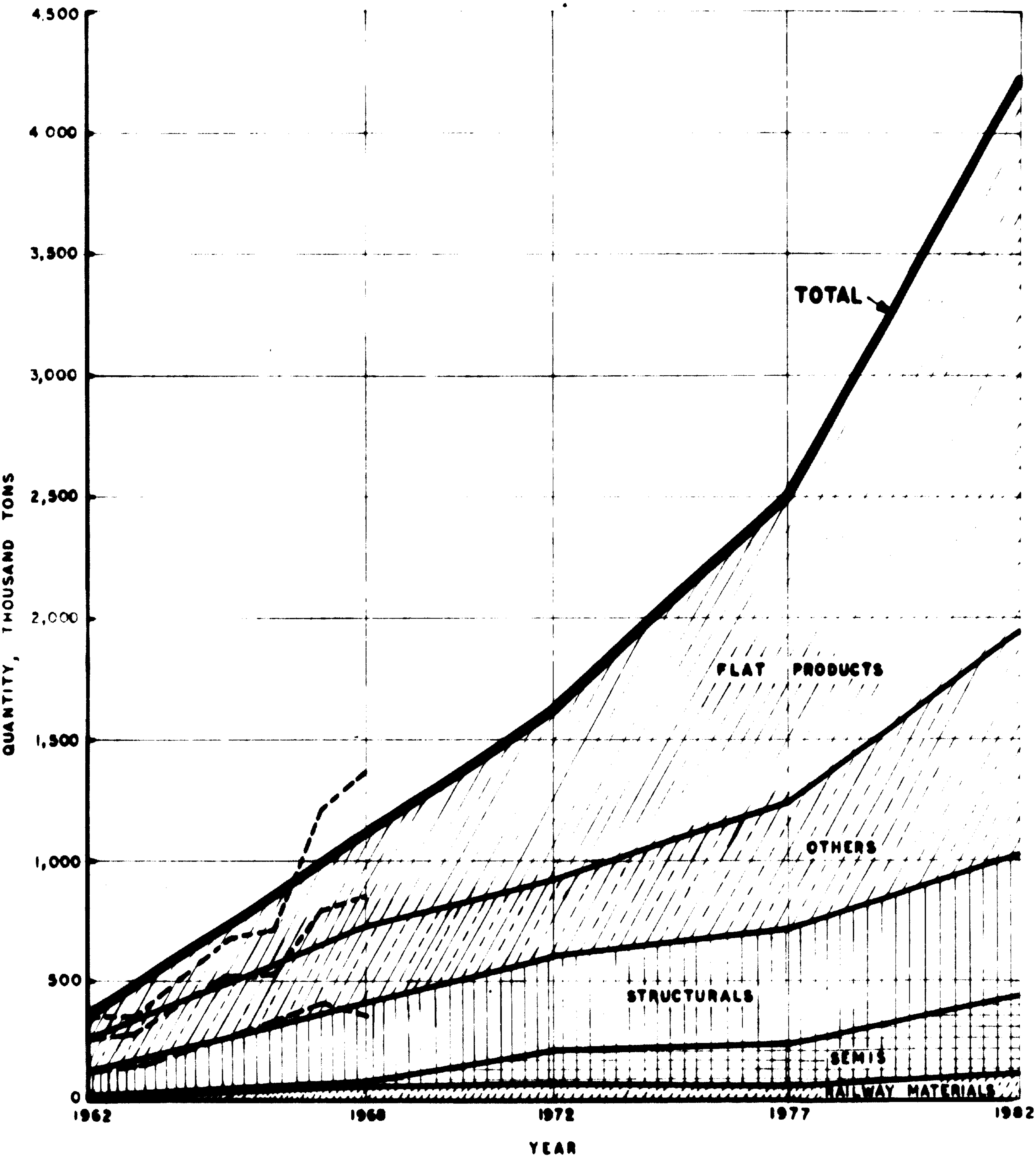

FIG. 6-6: CATEGORYWISE TOTAL TONNAGE STEEL DEMAND

6 - Steel demand analysis (cont'd)

The total demand of tonnage steel by sectors is given in Table 6-5 and shown in Fig. 6-7.

Table 6-5

TOTAL DEMAND OF STEEL BY SECTORS

	1972		1977		1982	
	Tons	%	Tons	%	Tons	%
A. Transport equipment	92 676	5.50	207 647	8.30	366 648	8.70
B. Electrical equipment	40 584	2.40	69 705	2.80	145 479	3.50
C. Industrial and agricultural machinery	32 184	2.00	86 471	3.40	140 977	3.50
D. Metal products	596 306	36.50	880 960	35.20	1 521 351	36.20
E. Constructional and allied activities	703 009	44.40	956 066	38.00	1 382 841	32.70
F. Spares and maintenance	76 200	4.50	124 300	5.00	217 000	5.40
G. Small and medium scale industries	57 772	3.50	141 122	5.70	371 492	8.80
H. Stocks	22 000	1.20	38 000	1.60	54 000	1.20
Total	1 620 751	100.00	2 502 371	100.00	4 204 388	100.00
Say	1 621 000		2 502 000		4 204 000	

6 - Steel demand analysis (cont'd)

Demand trend

The trend of steel demand by principal consuming sectors is shown in Fig 6-7. Themaximum relative increase is observed both in industrial and agricultural machinery and metal products. The steel demand by industrial and agricultural machinery rises from 8,000 tons in 1968 to an estimated 141,000 tons by 1982. In case of metal products the demand rises from 315,000 tons in 1968 to 1.521 million ton in 1982. This sharp increase is explained by the fact that some units now being set up for manufacture of industrial and agricultural machinery will commence production within a year or two, while several other big projects are under active consideration. The past production of industrial and agricultural machinery is insignificant, being limited to some parts of tea processing machinery, pistachio hulling machinery, concrete mixers etc. In case of metal products the increase is due to the fact that due to rapid industrialisation of Iran there will be greater demand for finished metal products such as window and door profiles, tin cans, etc. In case of transport and electrical equipment, the production of steel consuming items is already sizable and,therefore, the relative rise in steel demand is not as steep as in the case of industrial and agricultural machinery although in terms of actual tonnage the increases are much greater.

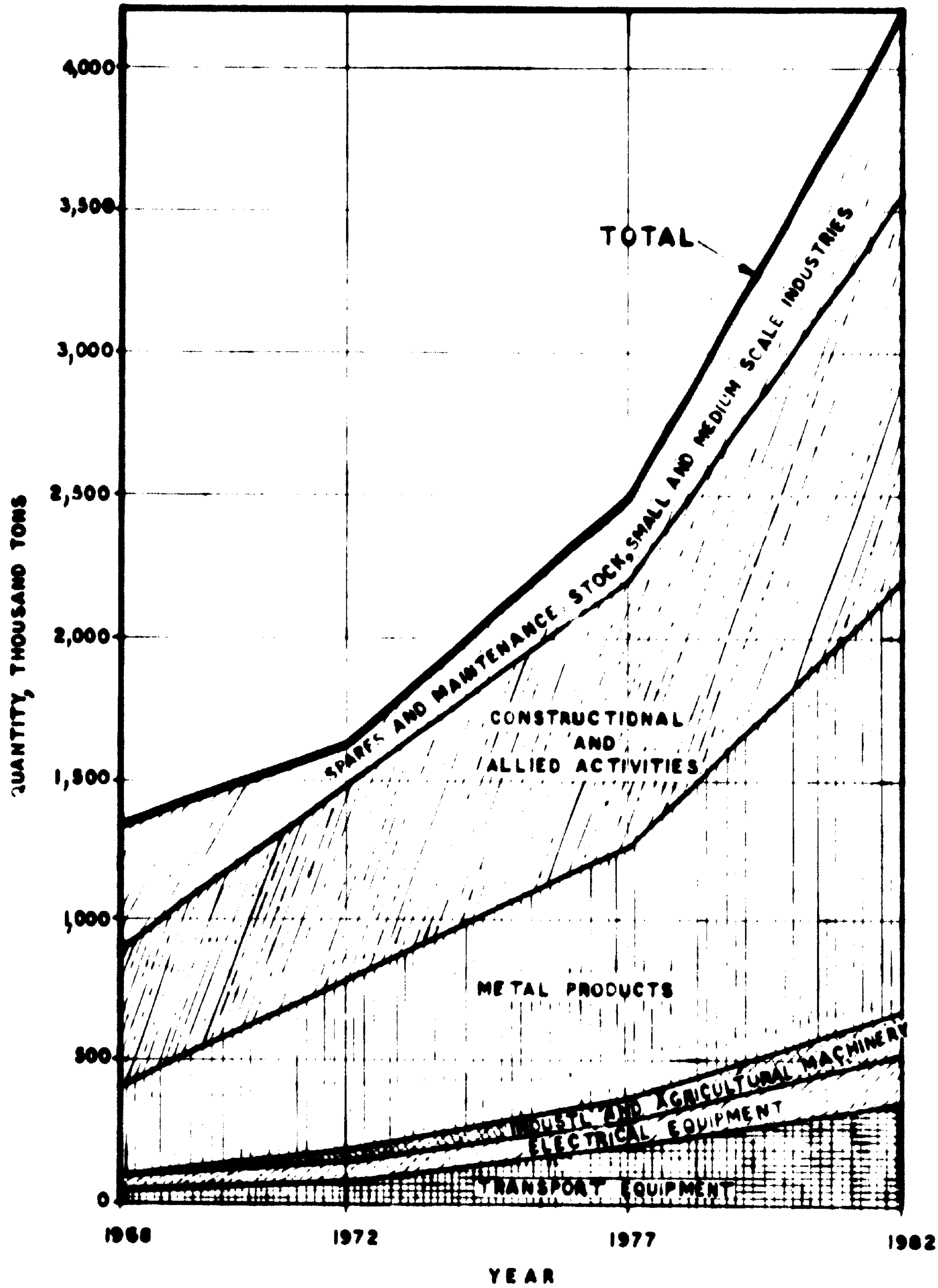

FIG. 6-7: SECTORWISE DEMAND OF TONNAGE STEEL

6 - Steel demand analysis (cont'd)

Forecast by alternative methods

Alternative methods

The total steel demand figures as well as the forecasts of output levels of steel consuming items need to be cross checked by other independent methods of projection to arrive at objective and realistic final estimates. However, on account of paucity of data on past production and consumption, the application of those alternative methods to steel consuming items had necessarily to be restricted to those items for which reliable data on past consumption were available.

Out of the total of 76 manufactured items considered for estimating tonnage as well as alloy steel demand, suitable series for time-trend and regression analysis could be developed for 34 items. The 34 items along with four alloy steel consuming items for which alternative forecasting methods could be adopted are listed in Table 6-6.

Details of the forecasting method, equations fitted and the projected values derived from the equations are given in Appendix 6-13.

6 - Steel demand analysis (cont'd)

Table 6-6

FORECAST BY ALTERNATIVE METHODS

Sector	Methods adopted	Reference App. No
A. Transport equipment		
Buses and minibuses	Time-trend	6-14
	Regression	6-15
Passenger cars	Time-trend	6-16
	Regression	6-17
Trucks	Time-trend	6-18
	Regression	6-19
Jeeps, station wagons, ambulance and vannets	Time-trend	6-20
Mopeds	Time-trend	6-21
Motor cycles and scooters	Time-trend	6-22
Automobile ancillaries	Time-trend	6-23
Bicycles complete	Time-trend	6-24
Auto leaf springs	Time-trend	6-25
B. Electrical equipment		
Transformer	Correlation with energy consumption	-
Switchgear and control gears	Graphical extrapolation	-
Electric fans	Time-trend	6-26
	Regression	6-27

6 - Steel demand analysis (cont'd)

Table 6-6 - Forecast by alternative methods (cont'd)

Sector	Methods adopted	Reference App.No.
B. Electrical equipment (cont'd)		
Air coolers	Time-trend	6-28
	Regression	6-29
Refrigerators	Time-trend	6-30
Water coolers	Time-trend	6-31
	Regression	6-32
Water heaters	Time-trend	6-33
	Regression	6-34
Radio receivers	Time-trend	6-35
	Regression	6-36
Television sets	Time-trend	6-37
C. Industrial and agricultural machinery		
Other material handling equipment	Time-trend	6-38
Industrial boilers	Time-trend	6-39
	Regression	6-40
Air compressors	Time-trend	6-41
D. Metal products		
Steel wire ropes and chains	Time-trend	6-42
	Regression	6-43
Bolts, nuts and rivets	Time-trend	6-44
	Regression	6-45
Ball and roller bearings	Time-trend	6-46
	Regression	6-47
Builders' hardware	Time-trend	6-48
	Regression	6-49

LIST OF VOLUMES

6 - Steel demand analysis (cont'd)

Table 6-6 - Forecast by alternative methods (cont'd)

Sector	Methods adopted	Reference App. No
D. Metal products (cont'd)		
Tanks	Time-trend	6-50
Gas cylinders	Time-trend	6-51
Wire nails	Time-trend	6-52
Wire netting and wire products	Time-trend	6-53
Stoves	Time-trend	6-54
	Regression	6-55
Sewing machines	Time-trend	6-56
	Regression	6-57
Time cars	Time-trend	6-58
Arc welding electrodes	Time-trend	6-59
	Regression	6-60
Steel doors and windows	Time-trend	6-61
Heavy pipes and tubes	Time-trend	6-62
Razor blades	Time-trend	6-63
	Regression	6-64
Hacksaw	Time-trend	6-65
	Regression	6-66
Utensils	Time-trend	6-67

6 - Steel demand analysis (cont'd)

Comparison of forecasts of steel consuming items

The forecasts based on alternative methods (namely, field survey, plan programme and projections of past availability by time-trend and regression analysis based on the growth rate of related economic indicators) are tabulated for comparison in Table 6-7. Items for which suitable series could not be developed were excluded. The forecast figures marked with asterisks in Table 6-7 are the ones actually used for arriving at the steel demand estimates, since these represent probable output levels. These items account for more than 75 per cent of the total tonnage steel consumption for manufactured items. Therefore, the tonnage steel demand estimated on this basis is expected to have a reasonable degree of validity.

Table 6-8 lists the items in each sector for which forecast comparisons were made, the tonnage steel requirement for each of these items and the total steel requirement for the whole sector. It will be seen that barring industrial and agricultural machinery sector, the items compared account for a very large percentage of the total tonnage steel requirement of the individual sector. In the industrial and agricultural machinery sector there are only three items for which a comparison could be made as no suitable series could be established for the other

Table 6-7

COMPARISON OF OUTPUT FORECASTS OF [illegible]

Item		Unit	1972 Field survey	Plan programme	Import substitution	Time-trend	Regression	Field survey
A. Transport equipment								
1. Buses and minibuses	..	No	9 000*	-	-	11 315	14 200	25 000*
2. Passenger cars	..	No	80 000*	-	-	47 616	82 252	96 000*
3. Trucks	..	No	6 550*	-	-	8 850	10 356	12 500*
4. Jeeps, station wagons, ambulance and vannets	..	No	14 000*	-	-	11 796	-	28 000*
5. Motor cycles and scooters	..	No	30 000*	-	-	7 184	-	55 000*
6. Mopeds	..	No						
7. Automobile ancillaries	..	Million Rials	-	-	-	1 866*	-	-
8. Bicycles complete	..	No	-	100 000*	-	118 417	-	-
9. Auto leaf-springs	..	Ton	16 000*	-	-	15 206	-	21 600*
B. Electrical equipment								
10. Transformer	..	'000 KVA	1 000*	-	-	-	-	1 6[illegible]
11. Switchgear and control gear	..	Million Rials	-	-	200*	186	-	-
12. Electric fans	..	No	-	16 500*	-	100 400	107 505	-
13. Air coolers	..	No	80 000*	-	-	85 067	137 991	170 000*
14. Refrigerators (domestic and commercial)	..	No	500 000*	-	-	406 821	-	600 000*
15. Water cooler	..	No	10 000*	-	-	10 060	10 599	20 000*
16. Water heaters	..	No	185 000*	-	-	127 316	215 907	270 000*
17. Radio receivers	..	'000 No	340*	-	-	300	325	544*
18. Television sets	..	'000 No.	50*	-	-	55	-	115*
C. Industrial and [illegible] equipment								
19. Other material handling equipment		Million Rials	-	-	-	-	-	-
20. Industrial boilers	..	-do-	-	-	-	-	852	-
21. Air compressors	..	-do-	-	20*	-	65	-	-

SECTION 1

Table 6-7

Table 6-7

OF OUTPUT FORECASTS OF STEEL CONSUMING ITEMS

	1977					1982				
Regression	Field survey	Plan programme	Import a/ projection	Time-trend	Regression	Field survey	Plan programme	Import a/ projection	Time-trend	Regress
14 200	25 000*	-	-	25 375	26 000	45 000*	-	-	46 155	44 8
82 252	96 000*	-	-	67 116	126 265	162 000*	-	-	86 616	184 9
10 356	12 500*	-	-	16 690	20 833	22 000*	-	-	27 230	41 4
-	28 000*	-	-	29 659	-	50 000*	-	-	56 145	-
-	55 000*	-	-	13 674	-	88 000*	-	-	22 374	-
-	-	-	-	2 551*	-	-	-	-	3 196*	-
-	-	150 000*	-	142 917	-	-	500 000*	-	167 417	-
-	21 600*	-	-	20 406	-	28 000*	-	-	25 606	-
-	1 600*		-	-	-	2 560*		-	-	-
-	-	-	[illegible]	600	-	-	-	1 650*	1 650	-
187 505	-	250 000*	-	274 000	278 645	-	375 000*	-	378 000	380 5
157 901	470 000*	-	-	173 867	176 159	270 000*	-	-	295 000	222 3
-	600 000*	-	-	866 000	-	1 062 000*	-	-	1 470 000	-
10 509	20 000*	-	-	13 548	14 468	35 000*	-	-	16 656	18 7
215 907	270 000*	-	-	265 116	354 517	475 000*	-	-	452 216	550 0
325	544*	-	-	512	510	790*	-	-	775	8
-	116*	-	-	110	-	200*	-	-	191	-
-	-	100*	-	1 313	-	-	150*	-	1 763	-
652	-	160*	-	1 181	1 558	-	500*	-	1 556	2 7
-	-	200*	-	200	-	-	250*	-	356	-

. CONSUMING ITEMS

...me	1977 Import projection a/	1977 Time-trend	1977 Regression	1982 Field survey	1982 Plan programme	1982 Import projection a/	1982 Time-trend	1982 Regression
	-	25 375	26 000	45 000 *	-	-	46 155	44 800
	-	67 116	126 265	162 000 *	-	-	86 616	184 950
	-	16 690	20 835	22 000 *	-	-	27 250	41 481
	-	29 659	-	50 000 *	-	-	56 145	-
	-	13 674	-	88 000 *	-	-	22 374	-
	-	2 531*	-	-	-	-	3 196*	-
)*	-	142 917	-	-	500 000*	-	167 417	-
	-	20 406	-	28 000 *	-	-	25 606	-
	-	-	-	2 560*		-	-	-
	6[illegible]	600	-	-	-	1 650*	1 650	-
)*	-	274 000	278 645	-	375 000*	-	378 000	380 577
	-	175 867	176 159	270 000 *	-	-	295 000	222 379
	-	866 000	-	1 062 000*	-	-	1 470 000	-
	-	15 348	14 468	35 000 *	-	-	16 656	18 794
	-	265 116	354 517	475 000 *	-	-	452 216	550 072
	-	512	510	790 *	-	-	775	812
	-	110	-	200 *	-	-	191	-
)*	-	1 313	-	-	150*	-	1 765	-
)*	-	1 181	1 558	-	500*	-	1 556	2 710
)*	-	200	-	-	880*	-	356	-

SECTION 3

6 - Steel demand analysis (cont'd)

Item	Unit	1972 Field survey	Plan programme	Import projection a/	Time-trend	Regression	Field survey
D. Metal products							
22. Steel wire rope ..	ton.	-	-	-	2 095	1 164	-
23. Bolts, nuts and rivets	ton	-	-	8 000*	9 228	7 610	-
24. Ball and roller bearings ..	'000 No	-	5 000*	-	1 454	1 657	-
25. Builders hardware ..	ton	4 200*	-	-	3 203	5 476	7 500*
26. Tanks ..	ton	16 200*	-	-	14 763	-	18 380*
27. Gas cylinders ..	No	200 000*	-	-	416 300	-	600 000*
28. Wire nails ..	ton	11 000*	-	-	11 396	-	15 000*
29. Wire netting and wire products e/ ..	ton	-	-	2 080 e/	4 465	-	-
30. Stoves ..	No	200 000*	-	-	170 000	189 146	320 000*
31. Sewing machines ..	No	-	-	-	158 226	156 070	-
32. Tin cans f/ ..	ton	48 700*	-	-	46 982	-	59 300*
33. Arc welding electrodes	ton	19 000*	-	-	19 090	29 374	29 000*
34. Steel doors and windows	ton	64 000*	-	-	67 320	-	128 000*
35. Heavy pipes and tubes.	ton	310 000 h/	360 000	-	392 000	-	465 000* i/
36. Razor blades ..	million no	330*	-	-	423	393	450*
37. Hacksaw blades ..	'000 no	780*	-	-	1 110	1 105	1 110*
38. Utensils ..	ton	-	-	883*	1 115	-	-

* Forecasts of output denoted by asterisks have been considered for the demand projection.

a/ Where import statistics are available for only two or three years which are not adequate for time correlated economic indicator.

b/ Indigenous production has been estimated as a percentage of total demand assuming a progressive r

c/ The total demand includes springs as original equipment and for maintenance. The maintenance req

d/ Forecasts of transformers production on the basis of energy consumption have been discussed in Ap

e/ Taken as 15% of the total wire requirement. For 1972 output of wire netting and wire products h envisaged. For 1977 and 1982, 3112 tons and 6629 tons have been taken as output levels, on the

f/ The demands projected by time-trend and regression are higher than the planned output levels. In

g/ If substitution by plastics and glass increasing from 5% to 20% is considered, the net demand wil

h/ On the basis of Ahwaz pipe mill production at 85% of the installed capacity.

i/ Assuming 8% growth rate between 1972 and 1977 on 310 000 tons.

j/ Installed capacity on the basis of production attaining a level of 85% of capacity, i.e. $\frac{465,000}{0.85}$

k/ Assuming 6% growth rate between 1977 and 1982 on 465,000 tons.

l/ Installed capacity on the basis of production attaining a level of 85% of capacity, i.e. $\frac{625\ 000}{0.85}$

SECTION 1

Table 6-7

1972			1977					1982		
Import projection a/	Time-trend	Regression	Field survey	Plan programme	Import projection a/	Time-trend	Regression	Field survey	Plan programme	Import projecti…
-	2 095	1 164	-	-	-	4 878	2 637	-	5 000*	-
8 000*	9 228	7 610	-	-	10 000*	15 105	12 610	-	-	12 50…
-	1 454	1 657	-	10 000*	-	1 874	2 847	-	15 000*	-
-	3 205	5 476	7 500*	-	-	6 206	10 547	10 000*	-	-
-	14 765	-	18 380*	-	-	20 965	-	23 180*	-	-
-	416 500	-	600 000*	-	-	776 500	-	1 200 000*	-	-
-	11 396	-	15 000*	-	-	14 946	-	20 000*	-	-
2 080 b/	4 465	-	-	-	*5 112 b/	5 915	-	-	-	* 6 62…
-	170 000	189 146	520 000*	-	-	324 000	253 343	550 000*	-	-
-	158 226	156 070	-	100 000*	96 000	202 328 f/	194 830 f/	-	150 000*	134 0…
-	46 982	-	59 500*	-	-	66 482	-	75 000*	-	-
-	19 090	29 374	29 000*	-	-	29 115	44 898	40 000*	-	-
-	67 320	-	128 000*	-	-	89 922	-	234 000	-	-
-	392 000	-	465 000* i/	550 000 j/	-	450 000*	-	625 000 k/	735 000 l/	-
-	425	595	450*	-	-	610	486	660*	-	-
-	1 110	1 105	1 110*	-	-	1 385	1 640	1 320*	-	-
885*	1 115	-	-	-	1 546*	1 595	1 095	-	-	2 71…

…sidered for the demand projection.

…hree years which are not adequate for time-trend series, imports in 1968 have been projected on the basis of

…ge of total demand assuming a progressive rise in production, namely 10%, 50% or 100% for the three years und…
…t and for maintenance. The maintenance requirement is 25% of the total.
…nergy consumption have been discussed in Appendix 6-13.
…utput of wire netting and wire products has been taken as 990* tons only on the basis of indigenous producti…
…s have been taken as output levels, on the assumption that the entire quantity will be indigenously produced
… higher than the planned output levels. Indigenous production capacity envisaged cannot meet the entire dema…
…% to 20% is considered, the net demand will be 44,000 tons, 55,000 tons and 68, 500 tons respectively.
…e installed capacity.
…0 tons.
…g a level of 85% of capacity, i.e. $\frac{465,000}{0.85}$
…0 tons.
…g a level of 85% of capacity, i.e. $\frac{625,000}{0.85}$.

SECTION 2

Table 6-7 (continued)

	1977			1982				
...mme	Import projection a/	Time-trend	Regression	Field survey	Plan programme	Import projection a/	Time-trend	Regression
	-	4 878	2 657	-	5 000*	-	8 915	6 025
	10 000*	15 105	12 610	-	-	12 500*	16 978	20 542
...00*	-	1 874	2 847	-	15 000*	-	2 274	4 736
	-	6 208	10 547	10 000*	-	-	10 465	18 408
	-	20 965	-	25 180*	-	-	27 565	-
	-	776 500	-	1 200 000*	-	-	1 261 500	-
	-	14 946	-	20 000*	-	-	18 496	-
	*5 112e/	5 915	-	-	-	*6 629e/	7 565	-
	-	324 000	255 345	550 000*	-	-	548 000	329 659
...00*	96 000	202 328f/	194 850 f/	-	150 000*	154 000	246 426	258 180f/
	-	66 482	-	75 000*	-	-	85 982	-
	-	29 115	44 898	40 000*	-	-	39 140	79 869
	-	89 922	-	254 000	-	-	117 992	-
...00h/	-	450 000*	-	625 000h/	735 000i/	-	750 000*	-
	-	610	486	660*	-	-	798	614
	-	1 385	1 640	1 320*	-	-	1 660	2 490
	1 546*	1 595	1 095	-	-	2 717*	2 075	-

...nd series, imports in 1968 have been projected on the basis of growth rate of

... in production, namely 10%, 50% or 100% for the three years under study.
...ment is 25% of the total.
...ix 6-13.
...en taken as 990* tons only on the basis of indigenous production capacity
...umption that the entire quantity will be indigenously produced by that time.
...nous production capacity envisaged cannot meet the entire demand.
... 44,000 tons, 55,000 tons and 68, 500 tons respectively.

SECTION 3

SECTION 1

Table 6-8

TONNAGE STEEL REQUIREMENTS OF VARIOUS SECTORS AND OF MAJOR CONSUMING ITEMS IN EACH SECTOR

(All figures in thousand tons)

	1972			1977			1982		
	Steel requirement		Percentage	Steel requirement		Percentage	Steel requirement		Percentage
	Major items	Total sector	of total sector	Major items	Total sector	of total sector	Major items	Total sector	of total sector
A. Transport equipment									
Bus & minibuses	23.31			64.75			116.6		
Passenger cars..	39.70			73.73			128.91		
Trucks ..	12.20			23.40			41.1		
Jeeps, station wagons etc ..	7.52			15.00			26.9		
Motor cycles, scooters and mopeds ..	1.40			2.49			3.94		
Automobile ancillaries ..	1.01			5.30			10.4		
Bicycles complete	2.32			3.48			6.90		
Sub-total	87.46	92.70	94.35	188.15	207.65	90.61	334.75	366.6	91.31
B. Electrical equipment									
Switchgear and control gear..	0.65			2.08			5.4		
Electric fans ..	0.82			1.16			1.90		
Air coolers ..	2.35			4.08			6.5		
Refrigerators .. (domestic and commercial)	19.50			39.00			69.05		
Water coolers ..	0.35			0.73			1.38		
Water heaters ..	1.65			2.70			4.76		
Radio receivers	0.16			0.21			0.4		
Television sets	0.02			0.10			0.2		
Sub-total	25.50	40.58	62.34	50.06	69.70	71.32	89.57	145.48	61.57

C. Industrial and Agricultural machinery

B. Electrical equipment									
Switchgear and control gear..	0.65			2.08			5.4		
Electric fans ..	0.82			1.16			1.90		
Air coolers ..	2.35			4.08			6.5		
Refrigerators .. (domestic and commercial)	19.50			39.00			69.05		
Water coolers ..	0.35			0.73			1.38		
Water heaters ..	1.65			2.70			4.76		
Radio receivers	0.16			0.21			0.4		
Television sets	0.02			0.10			0.2		
Sub-total	25.50	40.58	62.84	50.06	69.70	71.32	89.57	145.48	61.57
C. Industrial and Agricultural machinery									
Other material handling equipment	-			0.98			1.35		
Industrial boilers	-			1.20			4.84		
Air compressors	0.05			0.16			0.35		
Sub-total	0.05	32.18	0.10	2.34	36.47	2.70	6.54	140.98	4.70
D. Metal products									
Steel wire rope and chains	-			-			5.5		
Bolts, nuts and rivets	12.00			15.00			18.6		
Builder hardware	2.50			4.37			5.8		
Tanks	15.96			21.01			28.6		
Gas cylinders	4.00			12.00			24.0		
Wire nails	12.20			16.20			21.6		
Wire netting and wire products	1.00			3.45			7.2		
Stoves	3.60			5.76			10.2		
Sewing machines	-			0.60			0.69		
Tin cans	53.46			66.00			82.39		
Arc welding electrodes	14.25			21.80			30.0		
Steel doors and windows	71.25			142.24			260.44		
Heavy pipes and tubes	372.00			515.00			953.00		
Sub-total	562.20	596.00	94.30	823.45	880.96	95.50	1 428.02	1 521.35	95.90
GRAND TOTAL	675.19	761.46	88.67	1 065.98	1 244.78	85.84	1 858.38	2 174.41	85.49

Table 6-8

SECTION 2

TABLE OF CONTENTS - VOLUME III

TABLES IN VOLUME III

Table 6-8

cultural machinery									
Other material handling equipment	-			0.98			1.35		
Industrial boilers	-			1.20			4.84		
Air compressors	0.05			0.16			0.35		
Sub-total	0.05	32.18	0.10	2.34	86.47	2.70	6.54	140.98	4.70
D. **Metal products**									
Steel wire rope and chains	-			-			5.5		
Bolts, nuts and rivets	12.00			15.00			18.6		
Builder hardware	2.50			4.37			5.8		
Tanks	15.96			21.01			28.6		
Gas cylinders	4.00			12.00			24.0		
Wire nails	12.20			16.20			21.6		
Wire netting and wire products	1.00			3.45			7.2		
Stoves	3.60			5.76			10.2		
Sewing machines	-			0.60			0.69		
Tin cans	53.46			66.00			82.39		
Arc welding electrodes	14.25			21.80			30.0		
Steel doors and windows	71.25			142.24			260.44		
Heavy pipes and tubes	372.00			515.00			953.00		
Sub-total	562.20	596.00	94.30	825.45	880.96	95.50	1 428.02	1 521.35	95.90
GRAND TOTAL	675.19	761.46	88.67	1 065.98	1 244.78	85.84	1 858.88	2 174.41	85.49

SECTION 3

6 - Steel demand analysis (cont'd)

items. Moreover, output levels and the corresponding steel demand for industrial and agricultural machinery would depend largely on the investment proposed in future rather than on past investment trends.

Comparison of tonnage steel requirements

The validity of the forecasts of total tonnage steel demand arrived at by the end-use approach, using microlevel projections, has been checked against macro-level projections of total tonnage steel demand derived by the application of time trend analysis and regression analysis - both simple and multiple - to total steel consumptions in past.

Time-trend analysis

Time-trend analysis of the past consumption of tonnage steel given in Appendix 6-68 shows that the representative equation is parabolic. The equation derived is:

$$y = 495 + 59.24t + 5.5t^2$$

The projections obtained on the basis of this equation are given in Table 6-9.

Table 6-9

TONNAGE STEEL DEMAND: FORECAST BY TIME-TREND ANALYSIS

Year	t	59.24 t	$5.5t^2$	y '000 tons
1972	10	592.4	550	1 637.4
1977	15	888.6	1 240	2 623.6
1982	20	1 184.8	2 200	3 879.8

6 - Steel demand analysis (cont'd)

Simple regression analysis

Regression analysis, taking national income as independent variable, gives the equation

$$y = 510 + 0.95x + .001x^2 \quad \text{(vide App 6-69)}$$

The projections derived are given in Table 6-10.

Table 6-10

TONNAGE STEEL DEMAND: FORECAST BY REGRESSION ANALYSIS WITH NATIONAL INCOME AS INDEPENDENT VARIABLE

Year	x a/ Billion Rials	0.95x	$0.001x^2$	y '000 tons
1972	780.9	765	610	1 875.00
1977	1 173.7	1 150	1 378	3 038.00
1982	1 686.6	1 653	2 845	4 998.00

a/ National income has been projected assuming 9.5% growth rate up to 1972, 8.5% growth rate between 1972 and 1977 and 7.5% growth rate between 1977 and 1982.

With index of industrial production as independent variable, the regression equation (vide Appendix 6-70) obtained is

$$y = -52 + 5.5x$$

The projections derived are given in Table 6-11.

Multiple regression analysis of tonnage steel was carried out by computer programming. Two sets of analyses were carried out taking index of industrial production and national income as the two independent variables in one set,

6 - Steel demand analysis (cont'd)

and investment in constructional activity and index of industrial production as the two independent variables in the other set.

Table 6-11

TONNAGE STEEL DEMAND: FORECAST BY REGRESSION ANALYSIS WITH INDEX OF INDUSTRIAL PRODUCTION AS INDEPENDENT VARIABLE

Year	x a/	5.5 x	Y '000 tons
1972	3.3.3	1 692	1 642.00
1977	551.4	2 978	2 928.00
1982	929.1	5 017	4 967.00

a/ Independent variable is the index of industrial production which has been projected assuming 12% growth rate between 1967 and 1972, 12% growth rate between 1972 and 1977, and 11% growth rate between 1977 and 1982.

With index of industrial production and national income as independent variables, the derived equation is:

$$y = 632.13 - 2.19 \bar{x}1 + 3.54 \bar{x}2$$

where $\bar{x}1$ = Index of industrial production with 126.00 as the average value

and $\bar{x}2$ = National income with 386.20 as the average value.

The derived values are given in Table 6-12.

Table 6-12

TONNAGE STEEL DEMAND: FORECAST BY MULTIPLE REGRESSION ANALYSIS

(Independent variables: Index of industrial production and national income)

Year	$\bar{x}1$	$\bar{x}2$	y '000 tons
1972	187.3	394.70	1 619.18
1977	425.4	787.50	2 488.25
1982	803.1	1 300.40	3 476.75

Results obtained with index of industrial production and constructional activity as the two independent variables are according to the equation:

$$y = 475.13 + 44.73\bar{x}1 - 0.36\bar{x}2$$

where $\bar{x}1$ = constructional activity with 26.30 as the average value

$\bar{x}2$ = Index of industrial production with 126.0 as the average value.

The projections derived are given in Table 6-13.

Table 6-13

TONNAGE STEEL DEMAND: FORECAST BY MULTIPLE REGRESSION ANALYSIS

(Independent variables: Constructional activity a/ and index of industrial production)

Year	$\bar{x}1$ billion Rials	$\bar{x}2$	y '000 tons
1972	31.20	187.3	1 [illegible]
1977	60.20	425.4	3 014.74
1982	96.00	803.1	4 [illegible]

a/ Constructional activity (billions of Rials at [illegible] constant price) given in Appendix 6-2, has been projected on the basis of national income growth rates given in page 6-5. The derived values are 37.5, 58.5 and 126.3 billion Rials (at [illegible] constant price) for the years 1972, 1977 and 1982.

6 - Steel demand analysis (cont'd)

During discussions on our Draft Report it was suggested by the Research Centre to carry out analysis on the past consumption of steel taking indirect imports together with direct imports. However, it may be mentioned that it is the established practice in all countries, whether highly industrialised, developing or under-developed, to consider only direct steel consumption for forecasting future demand. The reasons for this is that the history of past consumption takes into account the gradual changes in manufacturing pattern of steel consuming items. In rapidly developing economies the emphasis on self-reliance, by substitution of imported steel consuming items such as consumer durables, metal products, transport equipment, machinery etc, by establishing indigenous production capacity as quickly as possible, implies that such manufactured items will account for direct steel consumption in increasing measure and indirect consumption of steel in theform of imports of such items will be reduced. It does not mean, however, that indirect steel consumption will decrease rapidly in the near future. On the contrary, when a country is industralising rapidly for increased self-sufficiency, indirect steel consumption also increases rapidly in the early periods along with direct steel consumption, but later on indirect steel consumption will level off and then start falling gradually. But this indirect steel consumption will be far more sophisticated goods such as specialised machinery and equipment, intermediate products used for indigenous production and spares and replacements.

In developing economies, steel required for constructional and allied activities accounts for the greater part of the steel consumption in the early stages. As more and more indigenous manufacturing capacity is established the share of constructional and allied activities in direct steel consumption gradually falls. In Iran, steel consumption for constructional and allied activities was of the order of [illegible] to 50% of the total steel consumption in [illegible]. In [illegible] it was probably of the order of [illegible]%. In future years it will fall down gradually to much less than [illegible] as more and more steel consuming industries are established. Thus it will be apparent that rapidly increasing direct steel consumption is mainly attributable to manufacture of steel consuming items largely meant to replace imports of such items which accounted for indirect steel consumption in the past. Therefore, if indirect steel consumption is considered together with the direct steel consumption for projecting future steel demand by time-trend, regression and other overall projection techniques, there will be double counting which will give highly inflated and unrealistic demand estimates.

6 - Steel demand analysis (cont'd)

Tonnage steel demand forecasts by time-trend analysis taking into account both direct and indirect steel consumption are given in Table 6-14.

Table 6-14

TONNAGE STEEL DEMAND: FORECASTS BY TIME-TREND ANALYSIS

Year	t	Y Steel consumption
1972	2	3 280 144
1977	12	6 190 859
1982	17	10 101 574

It will be seen that the forecasts by non-linear equation which takes into account both direct and indirect steel consumption give very high figures which do not compare at all with projections made by other forecasting techniques including the end-use method, whereas the demand forecasts by non-linear equation which takes into account only direct steel consumption give realistic figures comparable with the demand projections arrived at by other forecasting techniques.

The projections derived by different methods are compared in Table 6-15 and shown in Fig. 6-8.

6 - Steel demand analysis (cont'd)

Table 6-15

COMPARISON OF TONNAGE STEEL DEMAND PROJECTIONS BY DIFFERENT METHODS

(All figures in thousand tons)

		Method of forecast				
			Simple regression		Multiple regression	
Year	End-use	Time-trend	On national income	On index of industrial production	On index of ind.prod. & natl.income	On index of ind.prod. & const.activities
1972	1 621	1 637	1 875	1 642	1 619	1 803
1977	2 502	2 624	3 028	2 928	2 408	3 015
1982	4 204	3 880	4 998	4 967	3 477	4 570

The above table indicates that the total tonnage steel demand estimated by end-use approach agrees well with the forecasts made by time-trend and multiple regression while theforecasts made by simple regression are not very far out.

The forecasts of tonnage steel demand derived by various techniques are shown in Fig. 6-8. It may be noted that the curve showing forecasts by the end-use method is midway between the two extreme curves, the top extreme representing projections by simple regression taking national income as independent variable and the bottom extreme representing projections by multiple regression taking index of industrial production and national income as the independent variables. Time-trend analysis and

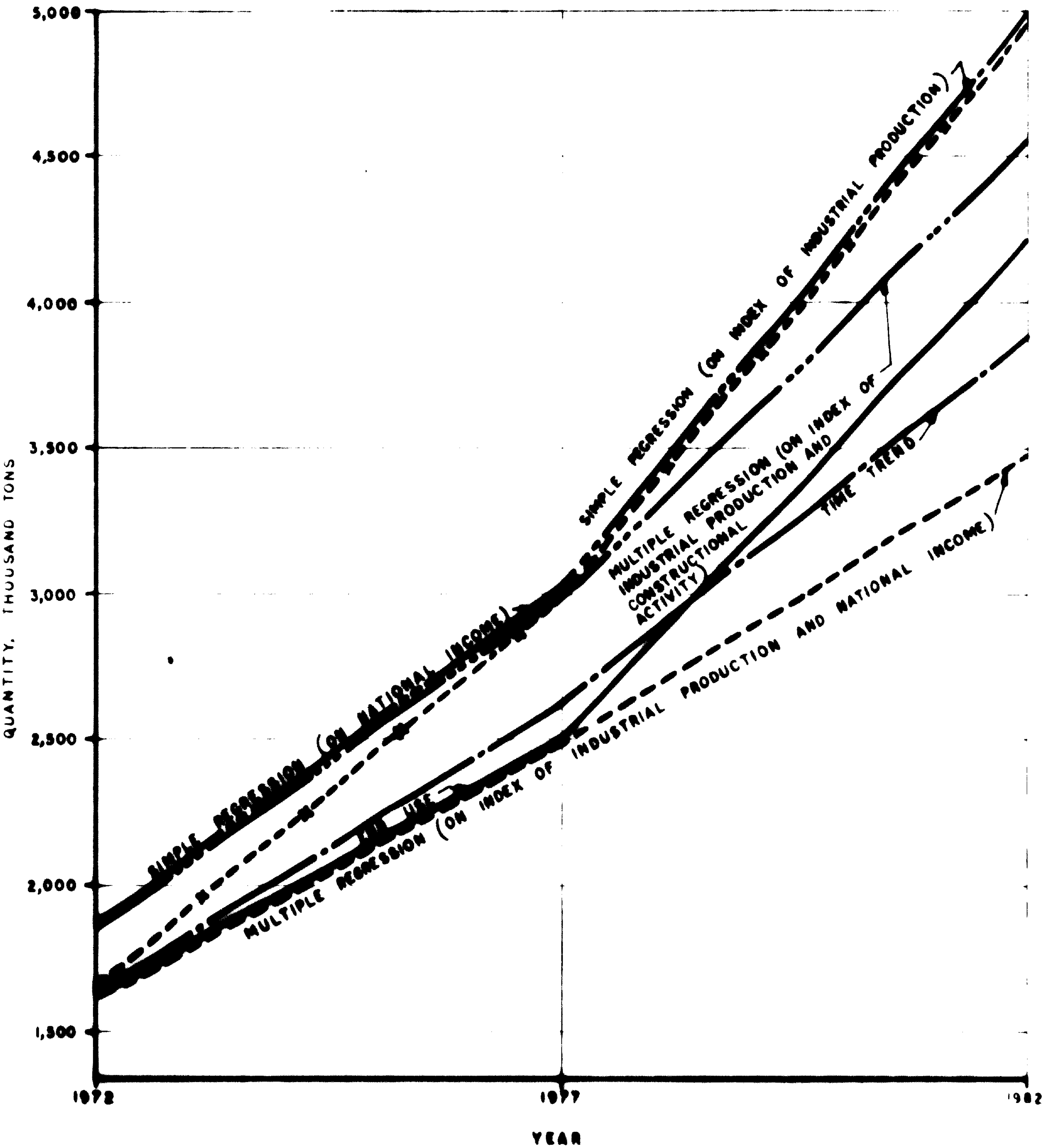

FIG. 6 –8: TOTAL TONNAGE STEEL DEMAND – FORECASTS BY VARIOUS METHODS

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TABLES (Cont'd)

multiple regression analysis taking index of industrial production and constructional activity as two independent variables give curves approximating to the end-use method curve, while multiple regression taking index of industrial production and national income as two independent variables is close to the end-use projections in the beginning but differs in later years.

__Elasticity__

As per capita income goes up, steel consumption will go up, the reason being that with higher income and corresponding improvement in the standard of living, people tend to buy more consumer durable goods, live in bigger and better homes, have their own transport and so on. The impact of income elasticity will be felt more on the demand for consumer durable goods than on other items.

The effect of price elasticity is the reverse of that of income elasticity. With increasing prices of commodities and materials, buying is toned down and the demand has a tedency to fall. It is difficult to take into account and determine with any degree of certainty the increase or decrease in steel demand due to income elasticity and price elasticity. Since the demand estimates for steel consuming items are in themselves derived from projections based on national income, per capita income and plan programmes intended to boost income and consumption levels, allowance for such factors as income elasticity and price elasticity is in-built to a considerable degree in these estimates, and therefore, no further adjustments need be made on this account.

Alloy steel demand

The output levels of steel consuming items have been discussed earlier in this chapter. For estimating alloy steel demand those items which do not consume alloy steels have been excluded.

Norms of consumption

The norms of consumption of alloy steels for different manufactured items have been derived by methods similar to those adopted for tonnage steel. The basis of calculation of these norms is given in Appendix 6-6 and the norms used for this study are given in Appendix 6-8.

Alloy steel demand

The norms of alloy steel consumption are applied to the estimated output levels of each item in order to determine the alloy steel requirement. Tool and die steels are not given in the norms sheets as these are process materials, except for items like band saw blades, hacksaw blades etc which are wholly made of tool steels. The requirement of tool and

6 - Steel demand analysis (cont'd)

die steel has been calculated as a percentage of total alloy steel requirement, as these percentages are fairly well established for countries in different stages of industrial development.

Sectorwise and typewise demand

The detailed analysis of the demand for alloy steels by each consuming sector and according to types, are given in Appendices 6-71, 6-72 and 6-73 and summarised in Tables 6-16 and 6-17.

Table 6-16

REQUIREMENT OF ALLOY STEELS a/
BY MAJOR CONSUMING SECTORS

(All figures in thousand tons)

	Consuming sector		1972	1977	1982
A.	Transport equipment	..	20.34	41.85	68.95
B.	Electrical equipment	..	5.47	10.26	15.78
C.	Industrial and agricultural machinery	..	6.39	16.09	25.02
D.	Metal products	..	5.82	12.56	17.03
	Total	..	38.02	80.76	126.78

a/ Excluding spares and maintenance, small scale industries, stock, defence, substitution and export requirements.

6 - Steel demand analysis (cont'd)

Table 6-17

REQUIREMENTS OF DIFFERENT TYPES OF ALLOY STEELS a/
BY MAJOR CONSUMING SECTORS

(All figures in thousand tons)

Type of steel		1972	1977	1982
Carbon constructional	..	3.16	7.48	12.01
Free cutting	..	1.53	3.43	5.86
Spring	..	11.22	21.98	36.08
Alloy constructional	..	14.46	32.81	49.81
Stainless	..	4.03	8.45	13.98
Electrical sheet	..	3.62	6.61	9.04
Total	..	38.02	80.76	126.78

a/ Excluding spares and maintenance, small scale industries, stock, defence, substitution and export requirements.

Alloy steel requirements for spares and maintenance, small scale industries, tool steels die blocks and stock

Spares and maintenance

The requirement for spares and maintenance has been discussed earlier in this chapter. On the same basis, 10 per cent of total alloy steel required for manufactured items has been provided for spares and maintenance.

Small scale industries

As explained earlier in this chapter, 4, 6 and 10 per cent of total steel requirements has been taken as provision for small scale industries for the years 1972, 1977 and 1982 respectively.

Tool steels

The requirement of tool steels is dependent on the production processes and quantity of tonnage steel processed. The proportion of tool steel in the total alloy

6 - Steel demand analysis (cont'd)

steel requirement will be high in the initial stages, but it will gradually diminish as production process as become more refined, massive and continuous, though the tonnage of tool steel will increase. For instance, in 1959 Japan was using 4.78 per cent as tool steel which decreased to 2.5 per cent in 1966. Accordingly, the tonnages of tool steel demand have been assumed at 6 per cent, 5 per cent and 4 per cent of alloy steel requirements of the major consuming sectors for the years 1972, 1977 and 1982 respectively, which work out to 5.0 per cent, 4.0 per cent and 3.1 per cent respectively of the total requirements of alloy and tool steels in these years.

Die blocks

Die blocks are required for forging and die blocks requirement has therefore been estimated on the basis of expected output of forgings. Requirement of forgings is generally about two per cent of the requirement of tonnage steel and the requirement of die blocks for forging is 10 tons on an average for 1,000 tons of forgings. On the above basis, the requirement of die blocks are given in Table 6-18.

Table 6-18

REQUIREMENT OF DIE BLOCKS

Year	Demand for tonnage steel tons	Estimated requirement of forgings tons	Estimated requirement of die blocks tons
1972	1 620 000	32 560	325
1977	2 500 000	50 040	500
1982	4 200 000	84 160	841

6 - Steel demand analysis (cont'd)

Stocks

A higher percentage of stock than in the case of tonnage steel has to be provided for alloy steels, because indigenous production is not likely to commence before 1977 and the entire demand has to be met from imports. In view of this, 2 per cent of the total alloy steel requirements has been assumed as requirement of stocks.

The requirements of different types of alloy steels including spares and maintenance, small scale industries, tool steels, die blocks and stock are given in Table 6-19 and shown in Fig. 6-9.

Table 6-19

TOTAL REQUIREMENT OF ALLOY STEELS a/
(All quantities in thousand tons)

Type of steel	1972		1977		1982	
	Mt	%	Mt	%	Mt	%
Carbon constructional	3.75	8.00	9.15	9.10	15.23	9.40
Free cutting	1.82	3.90	4.27	4.30	7.42	4.60
Spring	13.84	30.00	27.07	27.10	45.24	28.10
Alloy constructional	16.49	35.30	38.14	38.10	60.29	37.50
Stainless	4.75	10.10	9.72	9.70	16.07	10.20
Electrical sheet	3.72	8.00	7.07	7.10	10.37	6.50
Tool	2.28	5.00	4.00	4.00	5.04	3.10
Die blocks	0.32	0.70	0.50	0.50	0.84	0.60
Total	46.97	100.00	99.92	100.00	160.50	100.00

a/ Excludes defence, substitution and export requirements.

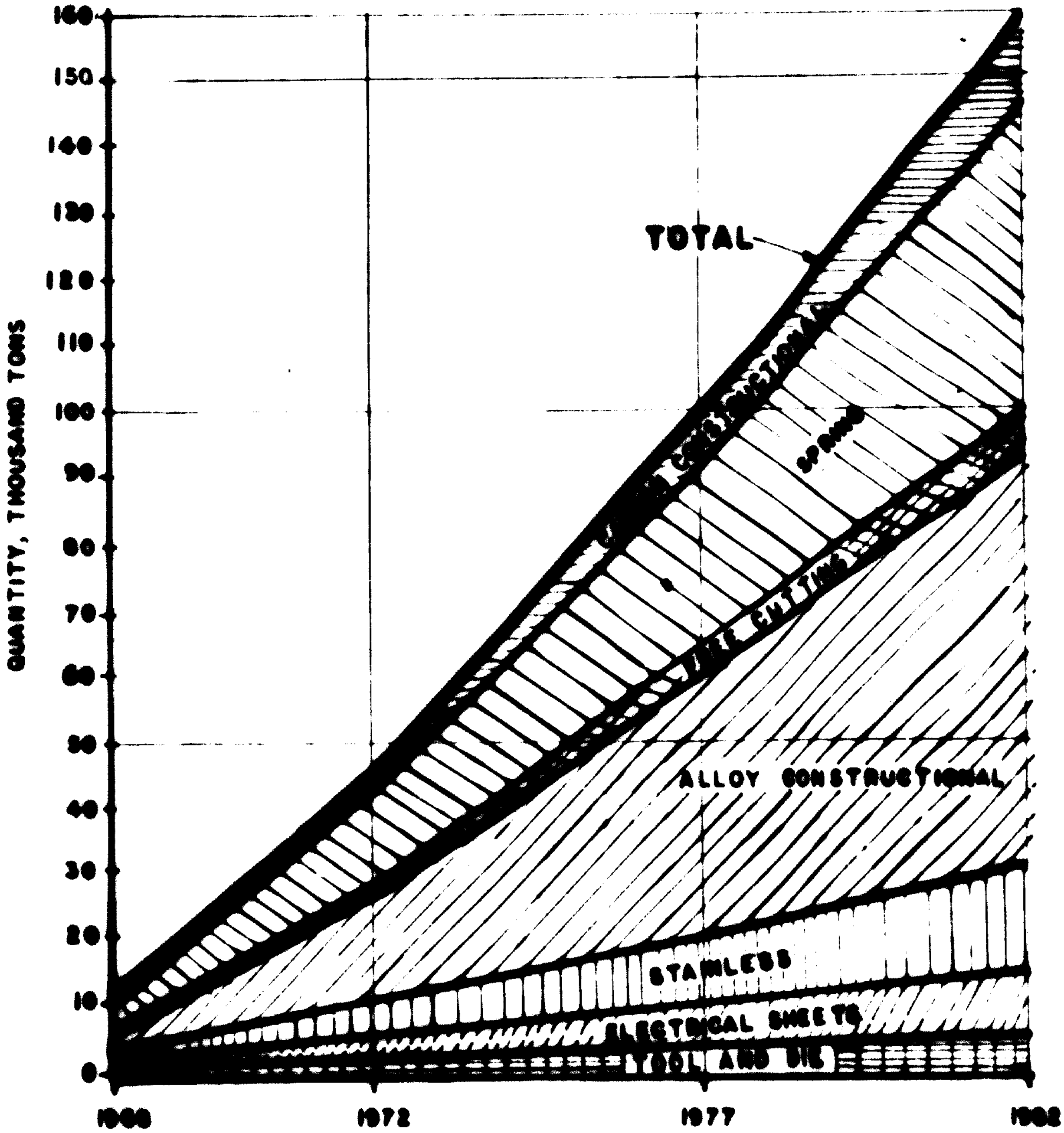

FIG. 6-9: TOTAL ALLOY STEELS DEMAND BY TYPES

6 - Steel demand analysis (cont'd)

The requirement of total alloy steels by sectors is given in Table 6-20 and shown in Fig 6-10.

Table 6-20

DEMAND OF ALLOY STEELS BY SECTORS
(All figures in thousand tons)

Sectors	1972		1977		1982	
	tons	%	tons	%	tons	%
Transport equipment	20.34	43.50	41.85	41.90	68.95	42.90
Electrical equipment	5.47	11.70	10.26	10.30	15.78	9.80
Industrial and agricultural machinery	6.39	13.60	16.09	16.10	25.02	15.60
Metal products	5.82	12.40	12.56	12.60	17.03	10.60
Spares and maintenance	3.78	8.20	8.29	8.30	12.64	7 90
Small scale industries	1.52	3.20	4.77	4.80	12.68	8.00
Tool steel	2.28	4.80	4.00	4.00	5.04	3.20
Die blocks	0.32	0.70	0.50	0.50	0.84	0.50
Stocks	0.75	1.50	1.60	1.50	2.52	1.50
Total	46.67	100.00	99.92	100.00	160.50	100.00

Typewise alloy steel demand: Fig 6-9

The trend of demand for alloy steels by steel types is shown in Fig 6-9. The sharp rise in demand indicates rapid growth anticipated in the manufacture of alloy steels consuming items. Large increase in demand for alloy constructional steel and spring steel are expected due to production of railway rolling stock, auto engines, springs for automobiles and wagons, etc.

Sectorwise alloy steel demand: Fig 6-10

The sector-wise alloy steel demand is indicated in Fig 6-10. The proportionate increase in demand is more or less similar in all the sectors. There is very little production of alloy and special steel consuming items in Iran at present. Though consumption of alloy steels was recorded in official statistics as 38,000 tons in 1968, only about 12,000 tons could be accounted for as consumption in the form of steel. Several plants for manufacture of items requiring alloy and special steel such as stationary diesel engines, vehicular diesel engines, chemical equipment, transformers, etc are under implementation. The aggregate alloy and special steel demand for direct consumption estimated at 12,000 tons in 1968 is expected to increase to 47,000 tons in 1972, 100,000 tons in 1977 and 161,000 tons in 1982.

The average growth rate for alloy steels between the period 1968 and 1982 is 23.3 per cent which is more than two times the average growth rate of 8.3 per cent for tonnage steel during the same period. This higher growth rate is the result of a low starting base with only a few alloy steel consuming industries existing at present, but many more of these industrial units are likely to be established in future.

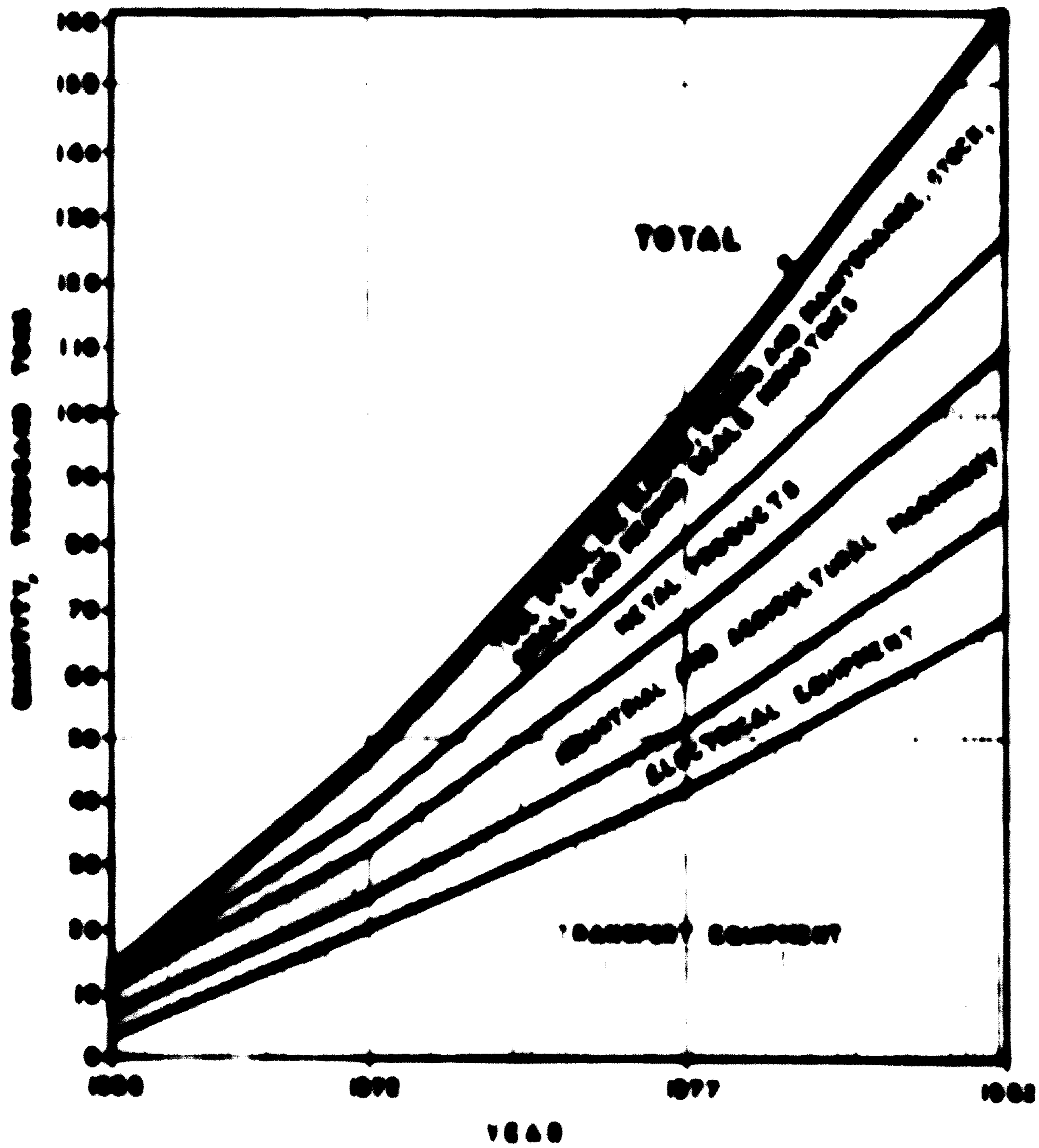

FIG. 6-10: SECTORWISE DEMAND OF ALLOY STEELS

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APPENDICES IN VOLUME III

6 - Steel demand analysis (cont'd)

Cross check of alloy steel demand

Method of cross-checking.

An attempt has been made to cross check the validity of the forecasts of total alloy steel demand arrived at by the end-use method by comparing them with the aggregate demand estimated by alternative techniques of forecasting such as time-trend and regression analysis.

Time-trend analysis.

Time-trend analysis of the past imports of alloy (Appendix [illegible]) gives the equation

y = [illegible] + [illegible] t

The projections derived on the basis of this equation are given in Table [illegible].

Table [illegible]

[illegible]

Year	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Regression on national income.

Regression analysis taking national income as independent variable is given in Appendix [illegible]. The equation obtained is:

y = [illegible]

and the projections derived on the basis of this equation are given in Table [illegible].

6 - Steel demand analysis (cont'd)

Table 6-22

ALLOY STEEL DEMAND : FORECAST BY REGRESSION ANALYSIS (WITH NATIONAL INCOME AS INDEPENDENT VARIABLE)

Year	x (billion Rials)	100 x	y (tons)
1972	790.3	78 090	53 000
1977	1 173.7	117 370	93 190
1982	1 686.6	168 660	144 460

Regression on index of industrial production

Taking index of industrial production as independent variable, the regression analysis (Appendix 6-76) shows the fitting equation

$$y = -923 + 140x$$

The projections derived on this basis are given in Table 6-23.

Table 6-23

ALLOY STEEL DEMAND : FORECAST BY REGRESSION ANALYSIS (WITH INDEX OF INDUSTRIAL PRODUCTION AS INDEPENDENT VARIABLE)

Year	x	140 x	y (tons)
1972	[illegible]3.3	43 [illegible]	42 [illegible]
1977	[illegible].4	77 [illegible]	[illegible] [illegible]73
1982	[illegible].1	130 [illegible]	1[illegible] [illegible]

6 - Steel demand analysis (cont'd)

Multiple regression analysis

Multiple regression analysis with national income and index of industrial production as two independent variables was done by computer programming. The equation derived is

$$Y = 16.19 + .04\,\bar{X}1 + .07\,\bar{X}2$$

where, $\bar{X}1$ = Index of industrial production with 132.43 as the average value

and $\bar{X}2$ = National income with 399.84 as the average value.

The projections obtained are given in Table 6-24.

Table 6-24

ANNUAL STEEL DEMAND: FORECAST BY MULTIPLE REGRESSION ANALYSIS

(Independent variables: index of industrial production and national income)

Year	X1	X2	Y '000 tons
1972	180.07	480.75	56.00
1977	410.97	774.44	67.50
1982	[illegible].67	1 207.38	130.10

Comparison with end-use estimate

Forecasts arrived at by the various techniques are compared in Table 6-25 and Fig 6-11.

It will be observed that the aggregate demand forecasts by time-trend and regression techniques do not agree well with the end-use estimates, except for some particular year or other. One major reason for this divergence is the inadequacy and confusing nature of basic statistical data on alloy steel imports during the past years which form the basis of the past consumption figures used in the analysis.

Table 6-25

ALLOY STEEL DEMAND: COMPARISON OF PROJECTIONS BY VARIOUS METHODS

(All figures in thousand tons)

Year	End-use	Time-trend	Simple regression a/	Simple regression b/	Multiple regression c/
1973	66.69	42.06	53.69	42.94	56.60
1977	99.12	60.36	93.17	76.27	97.20
1982	160.30	78.18	144.46	130.15	130.10

a/ National income as independent variable
b/ Index of industrial production as independent variable
c/ National income and index of industrial production as two independent variables.

It will be seen from Fig 6-11 that the simple regression line with national income as independent variable and multiple regression line with national income and index of industrial production as two independent variables are closer to the end-use forecast, whereas both the time-trend analysis and simple regression with index of industrial production as independent variable give much lower figures. Apart from the distortions resulting from the paucity of data on past consumption the disparity between the end-use estimates

6 - Steel demand analysis (cont'd)

and other forecasts is due to the difference in approach. While the end-use method is based on micro-level projections which take into account probable structural changes in the economy, macro-level projections by other techniques can be realistic only in the case of developed economies with fairly stabilised and well established consumption trends, where adequate and reliable data on past consumption are available over long periods. In the case of growing economy like Iran, close agreement between the end-use forecast and projections based on other statistical techniques cannot be expected. The end-use forecasts which are based on specific identification and detailed analysis of alloy steel consuming items and micro-level projections, are therefore, more acceptable.

The estimated alloy steel demand figures represent 2.9, 3.9 and 4.0 per cent of the aggregate tonnage steel demand in the years 1972, 1977 and 1982 respectively. These percentages are lower than in the case of highly developed industrialised countries whose alloy steel consumption varies between 6 and 11 per cent of tonnage steel. For instance, in India the present level of alloy steel consumption is about 4 per cent and it is expected to increase to 6 per cent by 1980.

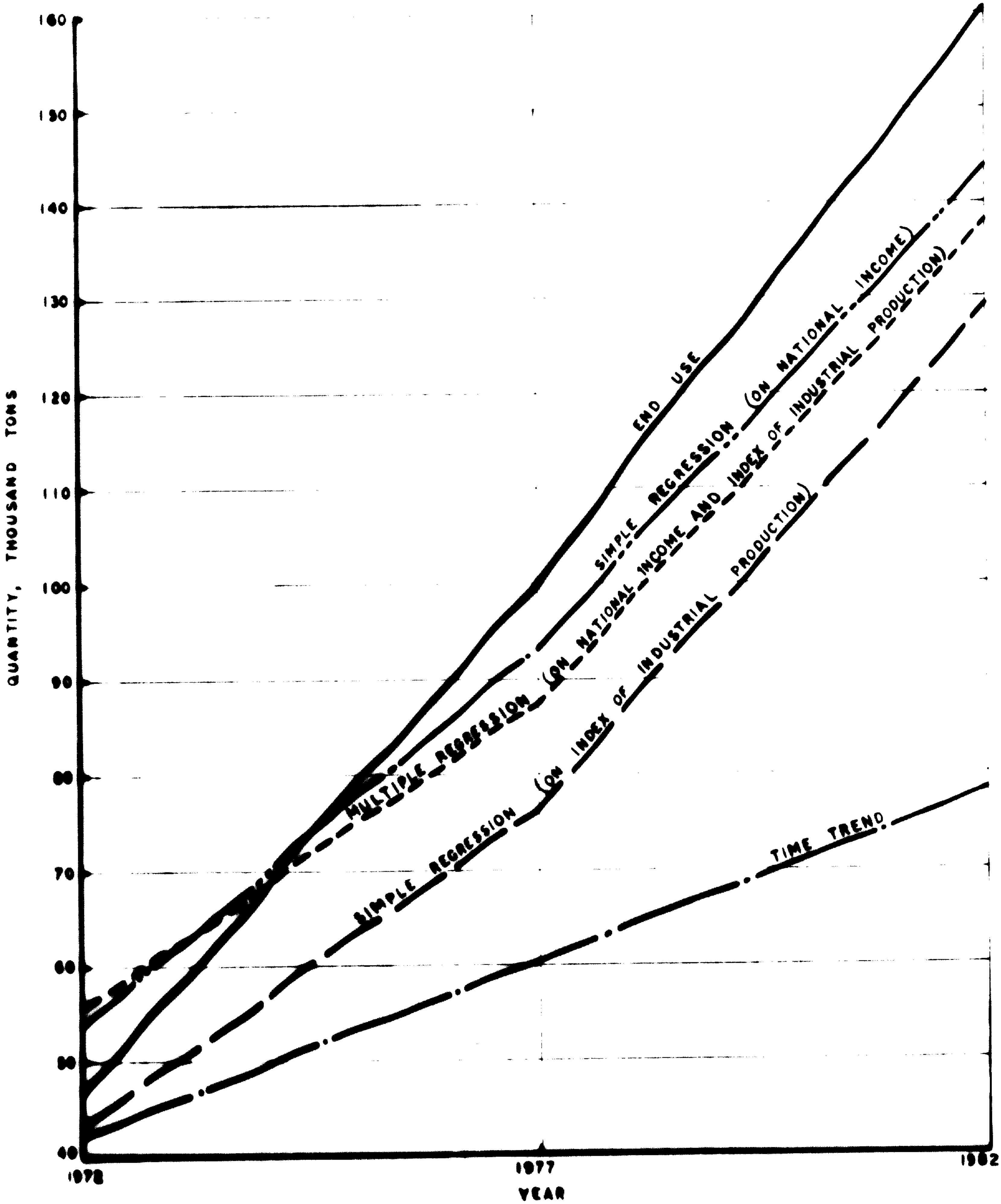

FIG. 6-11: ALLOY STEELS DEMAND—FORECASTS BY VARIOUS METHODS

6 - Steel demand analysis (cont'd)

As Iran progressively enlarges the industrial base for the manufacture of capital goods, the demand for alloy steel will be stimulated and will reach the levels envisaged.

APPENDICES

Appendix 6-1

ECONOMIC BASES OF FORECASTS

The items consuming ordinary steels and alloy steels are identified. Of these, the items manufacture of which is not likely to be taken up even by 1982, for example aircraft engines, turbo-generators, heavy metallurgical equipment etc were excluded.

Principally, emphasis was laid on the field survey results, and output levels for items which are under manufacture were ascertained in accordance with the anticipation of consuming industries. However, it may be mentioned here that appropriate adjustments were made where necessary so that the output levels given by industries were neither over or under-estimated, but reflected more realistic output levels for the purpose of this study.

For items which are not manufactured at present, but whose production is being planned, output levels have been assumed on the basis of planned programmes ascertained from the concerned authorities. For projecting output levels by 1982, the growth rates determined for the relevant items during the period 1960 - 1977 were applied.

In the case of items for which due to dearth of information no other reasonable basis of projection was available, time-trend

Appendix 6-1 (continued)

and regression analysis of past consumption (in many cases equivalent to import figures) was taken as guide lines for determining future output levels. Graphical extrapolations were also compared with projections derived from statistical methods so that the trend projected by time-trend and regression analysis does not widely differ from the current trends.

For some items production of which is expected by 1982 but not earlier, the output levels were determined on the basis of targets of production indicated in reports and proposals. In the case of items production of which is definitely anticipated by 1982, but for which specific proposals or reports are not available, the output levels are estimated by the application of assumed growth rate related to 1968 consumption levels.

For items like cement and sugar machinery, chemical equipment etc, the output levels were calculated assuming a certain percentage of the total investment in the sector as all the equipment and machinery are not likely to be manufactured indigenously even by 1982 and some equipment will still be imported. These percentages of total investment to which domestic output levels were related were derived on the basis of comparison with the achievements of those countries which are now more or less at the same level of industrial development which Iran is likely to reach by 1977 and 1982. The output levels thus forecast are given in Appendix 6-9.

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APPENDICES (Cont'd)

Appendix 6-1 (continued)

Forecast on the basis of field survey

The output levels obtained after collection of field survey data were adopted for assessing the steel demand. The items for which output levels were determined on the basis of field survey results are given below:

Item	Forecasts by industrial units up to the year
A. Transport equipment	
Buses and minibuses	1977
Cars	"
Trucks	"
Jeeps, station wagons, ambulances and vanetts	"
Auto leaf springs	"
Bicycles (pedal)	"
B. Electrical equipment	
Electric transformers	1978
Air coolers	1977
Refrigerators	"
Water coolers	"
Water heaters	"
Television sets	"
C. Industrial and agricultural machinery	
Agricultural tractors	[illegible]
Power driven pumps	1978
Tea processing machinery	"
Building and road construction machinery	"
D. Metal products	
Steel furniture	1977
Builders hardware	"
Gas cylinders	"
Stoves	"
Steel drums and containers	1978
Arc welding electrodes	"
Steel doors and windows	"
Heavy pipes and tubes	1977
Razor blades	[illegible]
Hacksaw blades	"

Appendix 6-1 (continued)

Forecasts based on plan programmes under active consideration or implementation

The plan programmes for items under implementation or active consideration were obtained from relevant authorities and Government agencies such as the Plan Organisation, Ministry of Economy, Industrial Credit Bank, Bank Markazi, Industries and Mining Development Bank etc. The output levels for the years under study namely 1972, 1977 and 1982 were estimated giving due consideration to technological factors such as yield, production in initial years, and possible extent of realisation of installed capacity. Installed capacities envisaged for such items and the year of commissioning expected are given in page 5.

Forecast based on imports

Switchgear and control gear

The imports of switch gear and control gear from 1964 to 1968 are given below:

Millions of Rials				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
41.6	130.00	136.56	260.4	479.3

Plotted in a graph, the import figures show an average increase of approximately 100 million Rials per year. However, the rise in imports at this rate cannot be expected to continue indefinitely, and it is logical to assume that at some point the rate of increase

SECTION 1

Item	Envisaged installation capacity	Expected year of commissioning	Source of information
I. [illegible]			
A. Transport equipment			
Railway wagons and trailers	-	-	Technology report
Motor cycles, scooters and mopeds	Initial 20 000 Nos Expansion 60 000 Nos	1971	Ministry of Economy
Automobile ancillaries	Initial 200 million Expansion 500 million	1972 1977	Automobile Ancillaries Project, Mitsubishi, Japan
Automotive diesel engines	Initial 12 000 Nos 1st stage expansion 24 000 Nos	197[illegible] 1980	Perkins and Leyland Plant in Tabriz
Bicycles	Initial 180 000 Nos Expansion 300 000 Nos	1971	Japanese proposal
B. Electrical equipment			
Electric transformers	Initial 1 000 - 1 600 KVA Expansion 26 000 KVA	1972-77 1982	Research Centre, Ministry of Economy
Electric motors	100 000 Nos	1972	Planned production programme of Tabriz Metallurgical Eng. [illegible] report on heavy electrical equipment
Transmission towers	Initial [illegible] tons Expansion 18 000 tons	1971 1981	[illegible] Report
Electronic equipment	[illegible] the total demand as indigenous production	-	Electronic Equipment Report
C. [illegible] and agricultural machinery			
Agricultural implements and/or tractors	[illegible] tons	1972	Arak Machine Building Plant [illegible] Center
Stationary diesel engines	4 [illegible] Nos	1972	Tabriz Metallurgical Eng. Plant
Cranes	1 [illegible] tons [illegible]	197[illegible]	Arak Machine Building Plant Programme
Passenger lifts	[illegible]	1972-77-[illegible]	Research Centre
Industrial lifts	[illegible] Nos	19[illegible]	
Farm lifts	[illegible]	[illegible]	Research Centre
[illegible]	[illegible]	[illegible]	[illegible] Building Plant

SECTION 2

[illegible]	[illegible]		[illegible]
			[illegible] Metallurgical Engg. [illegible] Report on [illegible] Electrical equipment
Transmission towers	Initial 12 000 tons expansion 18 000 tons	1971 1981	Annual Report
Electronic equipment	[illegible] of the total demand as indigenous production	-	Electronic Equipment Report
[illegible]			
Agricultural implements [illegible] tractors	3 000 tons	1972	[illegible] Machine Building Plant [illegible] Centr.
Stationary diesel engines	4 000 Nos	1972	[illegible] Metallurgical Engg. Plant
Cranes	1 000 tons [illegible]	1972	[illegible] Machine Bldg Plant Programme
Passenger lifts	200 - 400 - 600 Nos	1972-77-82	Research Centre
Industrial lifts	50 Nos	1982	
Dumb lifts	100 Nos	1981	Research Centre
Other material handling equipment	100 million [illegible]	1972	[illegible] Machine Building Plant
Irrigation valves	100 - 150 million [illegible]	1973-1982	[illegible] Machine Building Plant
[illegible]	[illegible] - [illegible] - [illegible] million [illegible]	1972-77-82	[illegible] Machine Building Plant
Power driven pumps	[illegible] - [illegible] - [illegible]	1972-77-82	[illegible] Metallurgical Engg. Plant
Machine tools	Initial [illegible] million [illegible] expansion [illegible] million [illegible]	1972 1982	[illegible] Machine Building Plant
[illegible]	Initial [illegible] Nos expansion [illegible] Nos	1972 1982	[illegible] Survey
[illegible]	Initial 10 Nos Expansion 60 Nos	1977 1982	Initial Report
[illegible]			
Ball and roller bearings	5 - 10 - 15 million Nos	1972-77-82	Ministry of Economy
Sewing machines	Initial 10 000 Nos expansion 20 000 Nos	1977 1982	Engineers' Proposal
[illegible]	5 000 tons	1970	Plan Programme

Appendix 4a (continued)

Fork lifts	[illegible]	[illegible]	[illegible]
Other material handling equipment	100 million [illegible]	1972	[illegible] Building Plant
Industrial boilers	100 - 200 million [illegible]	1973-1980	[illegible] Building Plant
Air compressors	10 - 200 - 300 million [illegible]	1973-77-80	[illegible] Building Plant
Power driven pumps	[illegible]	1973-77-80	[illegible] Plant
Machine tools	Initial [illegible] million [illegible] Expansion [illegible] million [illegible]	[illegible] [illegible]	[illegible] Building Plant
Dumpers and scrapers	Initial [illegible] Expansion [illegible]	[illegible] [illegible]	[illegible]
Shovels and excavators and road rollers	Initial 20 [illegible] Expansion [illegible]	[illegible] [illegible]	[illegible] Report
[illegible] Ball and roller bearings	[illegible]	[illegible]	Ministry of Industry
Sewing machines	Initial [illegible] Expansion [illegible]	[illegible] [illegible]	[illegible]
Household [illegible]	[illegible]	[illegible]	Plan Programme

[illegible]

Camps and [illegible]	.	.	Plan Programme
Agricultural and [illegible]	.	.	Plan Programme
Oil and gas	.	.	Plan Programme
Transport	.	.	[illegible] Report
Power supply	.	.	Ministry of [illegible]
Irrigation	.	.	Plan Programme
Roads and buildings	.	.	Plan Programme
Social services	.	.	Plan Programme
Telecommunication	.	.	Plan Programme
Airports	.	.	Plan Programme
Ports and [illegible]	.	.	Plan Programme

SECTION 3

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible] (continued)

[illegible]

[illegible] from 1964 to 1968 [illegible] growth rate of 14 per cent per year. Applying the compound equation $C = C_0 (1+r)^n$, the demand level by 1970 would be 100,000 units. After 1970, however, with the [illegible] per capita income and higher standards of living [illegible]. [illegible] this aspect in [illegible], a lower growth rate of 10 per cent per year [illegible] 1977 and 1980.

[illegible]

[illegible]

[illegible]	:	[illegible]
[illegible]	:	[illegible]
[illegible]	:	[illegible]

Appendix [illegible] (continued)

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

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[illegible]

[illegible]

[illegible] (continued)

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[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	-	[illegible]	[illegible]
[illegible]	-	[illegible]	[illegible]
[illegible]	-	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

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[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Appendix 6-1 (continued)

Projection has been made on the basis of the past growth rate of 18 per cent and output levels thus obtained are given below:

Year	Output (tons)															
1972	552	x	.6	+	552	=	331	+	552	=	883
1977	883	x	.75	+	883	=	663	+	883	=	1 546
1982	1 546	x	.75	+	1 546	=	1 161	+	1 546	=	2 717

Demand on the basis of correlation

Vehicular petrol engines

The demand figures estimated for cars are as follows:

(Nos)		
1972	1977	1982
80 000	93 000	162 000

The demand for vehicular petrol engines will be obviously equal to that for cars which use petrol engines. In vehicles such as trucks, jeeps etc diesel engines are utilised. Though the demand for vehicular petrol engines will be 80,000 in 1972, indigenous production may not exceed 10,000 as the proposed plant for vehicular petrol engines is not likely to be commissioned before mid 1972. Thereafter it is reasonable to assume that the production of engines will be augmented to catch up with the demand.

Public address system

Public address system equipment valued at 20 million Rials was imported in 1968. Based on a growth rate of 10 per cent observed for industrial production, the requirements by 1977 will be of the

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(continued)

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APPENDICES (Cont'd)

FIGURES IN VOLUME III

Appendix 6-1 (continued)

value of 72 million Rials. It is expected that certain items such as amplifiers, relays etc, which will account for approximately 10 per cent of the total demand will be manufactured in Iran by that time. Taking the same growth rate of 10 per cent beyond 1977, the estimated demand will be of the value of 120 million Rials. The percentage of indigenous manufacture by 1982 is assumed at 50 per cent, that is of 60 million Rials in value.

Textile machinery

According to information obtained from the Research Centre and Textile Industry in Iran, the only textile machinery to be manufactured by 1982 is for cotton textiles. After 1982 only, efforts may be made to manufacture wool and other textile machinery. Investment in the near future will thus be confined to cotton textile machinery. The plant for textile machinery is likely to go into production only in 1972. The total investment envisaged during the Fourth Plan on machinery for cotton textiles is 11,627 million Rials, that is 2,325 million Rials per year out of which 100 million Rials is expected to be produced in 1972. Taking a growth rate of 15 per cent per year beyond 1972, the investment on textile machinery will amount to 4,065 million Rials per year by 1977. Of this, 3,000 million Rials is taken as investment for indigenous production in 1977. On the basis of 10 per cent growth rate per year, 4,800 million Rials is taken as indigenous investment by 1982.

Appendix 6-1 (continued)

[illegible] plant and machinery

According to information obtained from the Ministry of Economy, on an average [illegible] plants, each plant costing about [illegible] million U.S. dollars, will go into operation every year. The total annual investment will thus be about [illegible] million Rials. About [illegible] per cent has been taken as indigenous manufacture by 1972, which will rise to [illegible] per cent by 1977. For 1982, [illegible] per cent growth rate has been taken on 1977 figures.

Cement plant and machinery

[illegible] plants are expected to be set up at the rate of two plants per year. The average cost of each [illegible] tons/day capacity plant is [illegible] million dollars or [illegible] million Rials. For two plants the investment is [illegible] million Rials. Taking [illegible] per cent and [illegible] per cent as the indigenous production content for 1972 and 1977, the value of cement plant machinery produced will be [illegible] million and [illegible] million Rials respectively. Taking [illegible] per cent growth beyond 1977, the indigenous output in 1982 will be [illegible] million Rials.

Equipment for chemical industry

The anticipated output levels of equipment for chemical industry have been derived on the basis of information furnished by the Research Centre. The anticipated outputs are [illegible], [illegible] and [illegible] tons for the years 1972, 1977 and 1982 respectively.

[illegible]

[illegible]

[illegible]

[illegible]		
[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] | [illegible]

[illegible] (continued)

[illegible]

[illegible]

Name of the project		Investment needed [illegible]
Dairy plant, [illegible]	..	[illegible]
Dairy [illegible]	..	[illegible]
Dairy farm, [illegible]	..	[illegible]
Dairy farm, [illegible]	..	[illegible]
[illegible] plant, [illegible]		[illegible]
[illegible] plant, [illegible]		[illegible]
	Total	[illegible]

[illegible]

Name of the project		Investment needed [illegible]
[illegible] plant		[illegible]
[illegible] plant		[illegible]
[illegible]	..	[illegible]
	Total	[illegible]

[illegible]

Name of the project		Investment needed [illegible]
Dairy plant, [illegible]	..	[illegible]
Dairy factory, [illegible] (Army project)		[illegible]
	Total	[illegible]

Appendix [illegible] (continued)

[illegible]

[illegible]
[illegible]

[illegible]	Investment needed [illegible]
Dairy factory, [illegible] ..	[illegible]
[illegible] pasteurizing plant, [illegible]	[illegible]
[illegible] pasteurizing factory, [illegible]	[illegible]
[illegible] plant, [illegible]	[illegible]
Dairy plant, [illegible] ..	[illegible]
Total	[illegible]

[illegible]
[illegible]

[illegible]	Investment needed [illegible]
Dairy factory, [illegible] ..	50 000
Dairy factory, [illegible] ..	50 000
Dairy factory, [illegible] ..	[illegible]
Total	[illegible]

For the period 1973-1977, the total investment on [illegible] and dairy product factories will be [illegible] million Rials, or an average of [illegible] million Rials per year.

Indigenous capacity for manufacture of dairy machinery is likely to be installed by 1975 and in all probability Iran will be able to manufacture about 50 per cent of the requirements of dairy

Appendix [illegible] (continued)

equipment and machinery by 1977. Thus, the value of the domestic output of dairy machinery and equipment by 1977 can be valued at [illegible] million Baht.

Assuming that the pattern of investment in dairy farms and [illegible] will not change [illegible] in the next [illegible] years, that is, it will continue at the rate of [illegible] to [illegible] million Baht per year till 1982, and the [illegible] demand will be met by domestic output by 1982, it is estimated that [illegible] will be producing equipment for the dairy industry of the value of [illegible] million Baht by 1982.

[illegible]

The import values of weighing equipment and parts increased from [illegible] million Baht in 1960 to [illegible] million Baht in 1969. The growth rate was derived from the annual import data for this period. The average curve drawn through the plotted points may be represented by the equation $Q_n = Q_o (1 + r)^n$.

Based on the different growth rates the demand estimate by 1970 is of the value of [illegible] million Baht. However, the above equation cannot be applied for estimating the demand by 1977 or 1982 as it is reasonable to expect a significant flattening of the demand curve. The demand by 1977 and 1982 have been estimated at 140 million Baht and [illegible] million Baht in value respectively, assuming non-cumulative growth rates of 15 per cent from 1970 to 1977 and 10 per cent afterwards up to 1982.

Appendix [illegible] (continued)

[illegible]

[illegible] of a feasibility [illegible] [illegible] [illegible]. Therefore, only [illegible] [illegible] [illegible].

[illegible]

[illegible]

[illegible]

[illegible]

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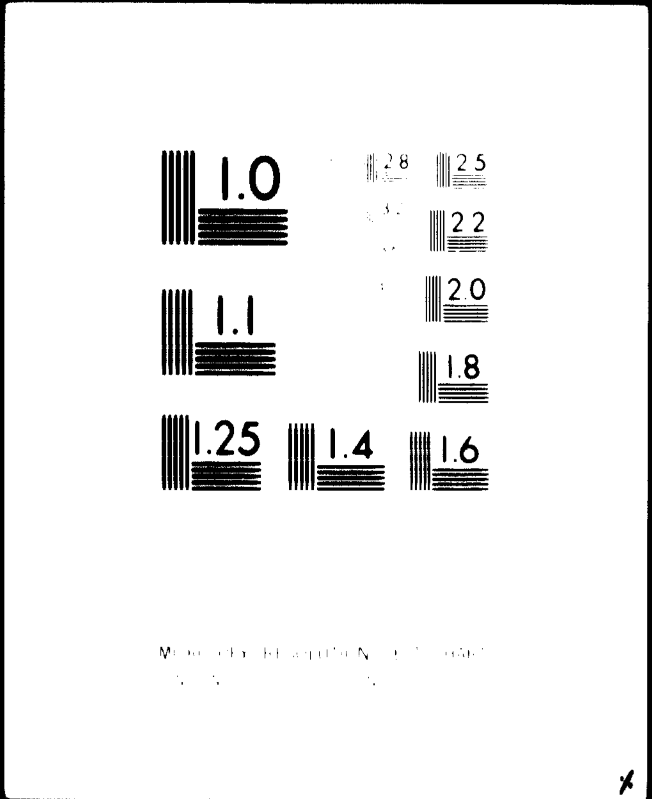

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Appendix 6-2

BASIC ECONOMIC INDICATORS OF IRAN

Appendix 6-2

9	1960	1961	1962	1963	1964	1965	1966	1967	1968
.9	289.8	295.0	301.6	323.0	334.2	376.7	412.8	497.4	550.0
.3	13.0	12.9	12.9	13.4	13.5	14.9	15.9	18.6	22.5
.7	22.2	22.8	23.4	24.0	24.7	25.3	26.0	26.7	27.5
.1	318.1	334.9	356.1	375.3	427.1	473.1	517.7	580.4	641.5
.1	56.5	55.3	43.7	49.4	63.9	82.0	90.0	108.0	124.2
.0	17.9	19.1	18.8	20.2	21.9	26.1	29.8	36.75	38.06
.0	75.0	81.0	92.0	100.0	114.0	127.0	143.0	170.0	181.0
7.4	333.3	341.3	350.0	374.1	387.9	437.3	480.8	562.4	624.0

xation and amortisation of fixed capital from gross national product.

tment plus exports of goods and services, consumption by both private and public sectors minus imports of

in s gives gross national product.

Teheran.

SECTION 2

Appendix 6-2

IRAN

962	1963	1964	1965	1966	1967	1968
01.6	323.0	334.2	376.7	412.8	497.4	550.0
12.9	13.4	13.5	14.9	15.9	18.6	22.5
23.4	24.0	24.7	25.3	26.0	26.7	27.5
56.1	375.3	427.1	473.1	517.7	580.4	641.5
43.7	49.4	63.9	82.0	90.0	108.0	124.2
18.8	20.2	21.9	26.1	29.8	36.75	38.06
92.0	100.0	114.0	127.0	143.0	170.0	181.0
350.0	374.1	387.9	437.3	480.8	562.4	624.0

d capital from gross national product.

services, consumption by both private and public sectors minus imports of

ct.

SECTION 3

Appendix 6-3

PROGRAMME OF RAILWAYS

The entire programme of construction of railway lines may be divided into two categories, namely those (i) under construction and (ii) proposed.

Railway lines under construction

At present about 800 km of railway lines are under construction in accordance with Bad-Yazd, Sarafhane-Ghotoor and Lufia-Zulfa schemes. The schemes are expected to be completed by 1971 and consequently there will be no demand of steel on this account beyond 1971.

Railway lines proposed

The Fourth Plan is scheduled to end by 1972, and about 1,500 km of railway track is proposed to be laid during the plan period under the Bad-Isfahan-Yazd and Yazd-Kerman schemes.

It is assumed that the construction of these lines will be equally phased over the five years of the Plan, with an additional 50 km in the last year of the Plan, namely 1972. Thus, the railway track length to be built in 1972 will amount to 350 km.

Appendix 6-3 (continued)

During the Fifth Plan, 2,050 km of new railway lines are proposed to be constructed. The programme of construction is as follows:

Sector		Track/km
Kerman-Zahadan	..	625
Yasd-Kerman-Bandar Abbas	..	625
Ghasr-Shirin-Saveh	..	800
Total	..	2,050

Out of 2,050 km of new railway lines proposed, it is envisaged that 1,500 km of new track urgently required to service the petro-chemical complex at Bandar Abbas will be completed during the Fifth Plan. There may be spill-over of the Kerman-Zehadan sector to the next Plan. In the Sixth Plan, to meet the needs of steel and aluminium industries strengthening of Abadan-Ahwaz-Arak trunk route will be required. It is envisaged that in addition to any spill-over from the Fifth Plan, 600 km of new railway lines will be laid during the Sixth Plan. The programme of construction is summarised in Table 6-3-1.

Electrification

Concrete proposals for electrification have not yet been formulated. Tentative schemes have, however, been drawn up for electrification of the trunk route to Bandar Abbas and of the Bad-Isfahan-Yasd section. The total route length is estimated at 1,425 km as under:

Appendix 6-3 (continued)

Table 6-3-1

PROGRAMME OF CONSTRUCTION OF RAILWAY LINES

(Figures in kilometers)

	Fourth Plan					Fifth Plan					Sixth Plan
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978-82
Railways under construction ..	200	200	200	200	-	-	-	-	-	-	-
Proposed construction under the fourth and subsequent plans ..	300	320	300	300	350	300	300	300	300	300	1,150
Total ..	500	500	500	500	[illegible]	300	300	300	300	300	1,150

SOURCE: Plan documents. Ministry of Railways, Iran.

Appendix 6-5 (continued)

Route		Length/km
Yazd-Kerman main line to Bandar Abbas	..	625
Ghom to Bad ..	..	150
Bad-Isfahan-Yazd ..	..	650
Total	..	1 425

Of this, a 550 km length is expected to be completed during the Fifth Plan and the balance in the Sixth Plan. So the electrification of 875 km, in addition to other schemes which may be proposed in the interim, will be taken up in the Sixth Plan period. It is estimated that route length electrified in 1982 will be 300 km.

Summarising, the annual railway route electrification programme will be as shown below:

Year		Route length electrified km
1972	..	100
1977	..	150 a/
1982	..	300

a/ It is assumed that the construction of 550 km of railway track will be equally spread over the five years with an additional 50 km for the year 1977.

Signalling and safety work

For signalling and safety works, only new lines to be laid are to be considered, namely 350 km in 1972, 300 km in 1977 and 600 km in 1982.

Appendix 6-3 (continued)

Track renewals

The existing track length in Iran is 3,620 km. Including 1,810 km for sidings etc, the total track length will be 5,430 km. On an average, renewal frequency is once in 40 years, which gives a renewal rate of 136 km per year. It may be mentioned, however, that the renewal requirements will increase gradually as track length goes up; but in view of the long time interval of 40 years between renewals, the effect on steel demand may be considered negligible for the purpose of the present study.

Maintenance

Apart from track renewal, steel is also required for maintenance of rolling stock. For this study, only wagon maintenance requirements have been taken into account. The total number of wagons on line in 1969 was recorded as 5,768. Taking frequency of overhaul to be once in three years, the total number of wagons overhauled in 1969 would be 1,922. For subsequent years, the number of wagons to be manufactured and placed on line have been added to the total 'park', as shown in Table 6-3-2.

Table 6-3-2

NUMBER OF WAGONS FOR OVERHAUL

Year	No. of wagons on line	No. of wagons requiring overhauling
1969	5 768	1 922
1972	6 800	2 200
1977	9 000	3 000
1982	13 200	4 400

Appendix 6-4

PROGRAMME FOR POWER GENERATION AND TRANSMISSION

The Ministry of Water and Power has prepared a planned programme for generation and distribution of power spread over a period of twenty years, that is up to the end of the Seventh Plan. This has been taken as the guide line for estimating power generation and distribution for the years 1972, 1977 and 1982.

Generating capacity

According to information obtained from the Ministry of Water and Power, power generating capacities proposed for installation by the end of each plan period, commencing with the Third Plan are given in Table 6-4-1.

Table 6-4-1

INSTALLED CAPACITY AT THE END OF PLAN PERIOD COMMENCING WITH THE THIRD PLAN

Plan	End Year		Power generation capacity			
	Iranian	A.D.	Installed MW	Retired MW	Net addition MW	Total capacity available MW
III	1346	1967	-	-	-	864
IV	1351	1972	1 904	216	1 688	2 552
V	1356	1977	2 189	40	2 149	4 701
VI a/	1361	1982	2 725	-	2 725	7 426

a/ The installed capacity at the end of the Sixth Plan has been estimated on the basis of 7% growth rate.

Appendix 6-4 (continued)

Assuming that addition of capacity will be achieved by eqully phased programmes, the yearly additions will be as given in Table 6-4-2.

Table 6-4-2

ADDITIONS TO POWER GENERATING CAPACITY

Plan	End year		Total addition	Yearly addition
	Iranian	A.D.	MW	MW
IV	1351	1972	1 688	338
V	1356	1977	2 149	430
VI	1361	1982	2 725	545

Additional power generating stations proposed by the Ministry of Water and Power need to be taken into consideration for checking the power generating capacity likely to be available in the years 1972, 1977 and 1982.

Additional generating stations and the capacities proposed for the Fourth Plan period are given in Table 6-4-3.

Table 6-4-3

GENERATING STATIONS AND CAPACITIES: FOURTH PLAN PERIOD

Location		Capacity (MW)		
		Hydel	Thermal	Total
Moghan dam	..	20	-	20
Gorgam	..	-	100	100
Manjil	..	-	100	100
Amir Kabir	..	43	-	43
Sanandaz	..	-	15	15
Reza Sah	..	1 000	-	1 000
Karun	..	420	-	420
Total	..	1 483	215	1 648

Appendix 6-4 (continued)

Assuming an equally phased programme, the yearly additions of generating capacity will be as follows:

Type of generator		Total addition of capacity MW	Yearly addition MW
Hydel	..	1 483	296.50
Thermal	..	215	43.00
	Total	1 698	339.50

In view of the rapid industrialisation programme and rural electrification scheme proposed for the Fourth Plan, the total additional power generation in 1972 may be taken as 350 MW, consisting of 300 MW hydel power and 50 MW thermal power.

The generator additions proposed for the Fifth Plan period are given in Table 6-4-4.

Table 6-4-4

GENERATING STATIONS AND CAPACITIES: FIFTH PLAN PERIOD

Location		Capacity (MW) Hydel	Thermal	Total
Tabriz	..	100	-	100
Mansil	..	-	100	100
Tarasht	..	-	140	140
Karun	..	510	-	510
Run of river	..	1 200	-	1 200
Total		1 810	240	2 050

On the basis of an equally phased programme, the yearly additions of generating capacity will be as follows:

Appendix 6-1 (continued)

The requirements for original equipment for the year 1977 and 1982 are 100,000 Nos and 150,000 Nos respectively corresponding to the requirement of the sewing machine for the years 1977 and 1982. Replacement is taken at the rate of two per machine. So total demand for sewing machine needles will be 300,000 and 450,000 Nos for 1977 and 1982 respectively corresponding to 1.25 and 1.87 tons.

Umbrella ribs

No import data is available. No information whether manufacture of umbrella ribs will be taken up was also not available. Demand data was evolved for 1977 and 1982 on the assumption that its manufacture might be taken up. Therefore, the requirements were calculated on the basis of Indian consumption figures based on correlation of population and umbrella ribs. According to Indian estimates, the ratio of umbrella ribs to population is 1 per cent. Iran being a drier country compared to India a lower ratio of 0.7 was adopted, to allow for climatic differences and habits between the two countries. On this basis, the requirements of umbrella ribs in Iran is as follows:

Year	Population a/ millions	Umbrella ribs millions
1972	30.455	0.21
1977	35.500	0.25
1982	42.300	0.30

a/ On the basis of formula $P = Poe^{rt}$ where

Po = initial population
r = growth rate
t = time

Appendix 6-4 (continued)

Type of generator		Total addition of capacity MW	Yearly addition MW
Hydel	..	1 810	362
Thermal	..	240	48
Total		2 050	410

The above figure of 410 MW of additional capacity per year tallies more or less with the yearly addition given in Table 6-4-2. Generating capacity added in 1977 has therefore been taken as 410 MW. Though stress is on installation of hydel power capacity, the gas turbine is likely to play an important role in Iran's future power generation schemes. Keeping this in view, the additional generating capacity of 410 MW per year is taken to consist of 350 MW hydel power and 60 MW thermal power.

The new generating stations and capacities proposed for the Sixth Plan period are given in Table 6-4-5.

Table 6-4-5

GENERATING STATIONS AND CAPACITIES: SIXTH PLAN PERIOD

Location		Capacity (MW)		
		Hydel	Thermal	Total
Mashad	..	-	100	100
Retusah	..	500	-	500
Karun	..	1 200	-	1 200
Run of river	..	900	-	900
Total	..	2 600	100	2 700

Appendix 6-4 (continued)

Assuming that the construction programme will be equally phased, the yearly addition of generating capacity will be as follows:

Type of generator	Total addition of capacity MW	Yearly addition MW
Hydel ..	2 600	520
Thermal ..	100	20
Total	2 700	540

On the basis of 7 per cent growth rate on 1977 figures, the total annual additional generating capacity will be 545 MW, which agrees well with 540 MW given above. However, thermal generating capacity of 20 MW is much lower than 60 MW assumed for 1977. Therefore, a 60 MW thermal generating capacity has been assumed for 1982 also and the balance 485 MW for hydel generation.

Transmission

The transmission programme drawn up by the Ministry of Water and Power indicates the route lengths of various lines already finalised/or under consideration. These are given in Table 6-4-6.

Table 6-4-6

ROUTE LENGTH OF POWER TRANSMISSION LINES

Line voltage	Plans III km	IV km	V km	VI km
400 kV ..	600	-	1 630	500
230 kV ..	780	1 840	1 100	1 450
132 kV and below	675	3 910	650	2 100
Total	2 055	5 750	3 380	4 050

Appendix 6-4 (continued)

Assuming an equally phased programme, the average yearly route length installed will be as given in Table 6-4-7.

Table 6-4-7

YEARLY PROGRAMME OF ROUTE LENGTH OF LINES

Line voltage	Plans IV km	V km	VI km
400 kV ..	-	326	100
230 kV ..	368	220	290
132 kV and below ..	782	130	420
Total	1 150	676	810

The yearly estimates derived by equal phasing for the different plans given in Table 6-4-7 show a marked discrepancy in 400 kV lines which has jumped from nil to 326 km in the Fifth Plan and dropped down sharply in the Sixth Plan. The steady growth in industrialisation will necessitate increasing transmission of power by 400 kV lines and it is presumed that there will be greater emphasis on 400 kV lines during the Sixth Plan than indicated by Table 6-4-7. Considering all transmission line voltages, the total yearly estimate for the Fifth Plan seems to be too low in comparison with the Fourth Plan. Therefore, the programmes for 1972, 1977 and 1982 have been estimated not on the basis of equally phased programmes but on the basis of a staggered programme given in Table 6-4-8, sequences of which have been fixed on the basis of discussions with the Ministry of Water and Power.

Table 6-4-

STAGGERED PROGRAMME OF ROUT

(All figures in

Line voltage		Fourth Plan 1968	1969	1970	1971	1972	1973	1974
400 kV a/	..	-	-	-	-	-	100	100
230 kV b/	..	200	230	300	340	430	200	200
132 kV and below c/	..	500	500	400	300	200	650	650

a/ The total route lengths proposed for the different periods have been staggered, taking into cons the Fifth Plan is 1,630 km. It has been estimated that only 800 km, that is about 50 per cent w be completed in the Sixth Plan, together with its own small programme of 500 km.

b/ Out of 1,840 km proposed for the Fourth Plan, it is estimated that the bulk amounting to 1,500 k over into the Sixth Plan and together with 1,100 km proposed for the Fifth Plan, a total of 1,4

c/ Out of 3,910 km proposed for the Fourth Plan, it is estimated that only 1,900 km will be actual the Fifth Plan. Together with 650 km proposed for the Fifth Plan, the total amounts to 2,660 k a carry-over of 210 km into the Sixth Plan. Together with 2,100 km proposed for the Sixth Plan Sixth Plan period.

SECTION 1

Tablo 6-4-8

Table 6-4-8

STAGGERED PROGRAMME OF ROUTE LENGTH OF LINES

(All figures in km)

	Fifth Plan					Sixth Plan				
1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
-	100	100	200	200	200	200	250	250	300	300
430	200	200	250	300	450	200	200	300	350	500
200	650	650	500	400	250	600	550	450	400	310

een staggered, taking into consideration the throw-forward possibility. Total route length proposed for km, that is about 50 per cent will be actually achieved within the Fifth Plan period. Balance 830 km will ramme of 500 km.

at the bulk amounting to 1,500 km will be completed within the plan period. The remaining 340 km is carried the Fifth Plan, a total of 1,400 km is expected to be completed in the Fifth Plan.

t only 1,900 km will be actually completed during the plan period and the balance will be carried over to , the total amounts to 2,660 km. It is expected that 2,450 km will be completed in the Fifth Plan, leaving km proposed for the Sixth Plan itself, it is expected that a total of 2,310 km will be completed in the

SECTION 2

6-4-8

Table 6-4-8

ROUTE LENGTH OF LINES

s in km)

	Fifth Plan				Sixth Plan				
74	1975	1976	1977	1978	1979	1980	1981	1982
00	200	200	200	200	250	250	300	300
00	280	300	450	300	200	300	350	500
50	500	400	250	600	550	450	400	310

consideration the throw-forward possibility. Total route length proposed for nt will be actually achieved within the Fifth Plan period. Balance 830 km will

500 km will be completed within the plan period. The remaining 340 km is carried 1,400 km is expected to be completed in the Fifth Plan.

tually completed during the plan period and the balance will be carried over to 50 km. It is expected that 2,450 km will be completed in the Fifth Plan, leaving Plan itself, it is expected that a total of 2,310 km will be completed in the

SECTION 3

Appendix 6-5

NOTE ON ORDINARY STEEL CONSUMPTION NORMS

The end-use method adopted for this study requires establishing norms of ordinary and alloy steel consumption for each consuming item. However, it may be mentioned here that certain items consume only either ordinary steel or alloy steel, and in some cases the amount consumed is insignificant. Accordingly changes have been incorporated in the list for assessing the ordinary and alloy steel requirement. Sixty-nine items/products in the organised industrial sector were identified as accounting for bulk of the consumption of steel. Of these sixty-nine items, seventeen do not consume alloy and special steel and consequently, for calculating alloy steel consumption norms these items were excluded. On the other hand, additional items such as razor blades, hacksaw and bandsaw blades and hand tools, which consume alloy steel, have been incorporated in the list. Items like aircraft engine, turbo-generator, diesel, steam and electric locomotive have not been considered at all, mainly because the possibility of these being manufactured indigenously even by 1982 is rather remote. For such items no norms of consumption need to be evolved.

Although a large number of the items considered are not produced at present in Iran, there are definite plans for production

Appendix 6-5 (continued)

of many of these in the near future. Some are expected to be under production by 1972, some by 1977 and others by 1982. For all such items consumption norms have been formulated on the basis of practices obtaining in other developing countries which approximate to Iranian conditions. The practices followed in Indian industries for these products are therefore considered relevant to formulating the consumption norms.

The steel requirement for each item comprises the steel content of the product plus the process scrap generated during its manufacture. The norms are given in terms of kilograms of ordinary steel/alloy steel per unit of output or value. In case of alloy steel consumption norms, indirect consumption relating to tools and tackles, dies etc required for manufacturing the products and/or parts have not been included. An overall requirement on this account has been estimated on the basis of percentage of total alloys and special steel. An attempt has also been made to breakdown the total steel consumption norms in terms of the various types of ordinary steels and alloy steels covered in this study. Brief explanatory notes on the derivation of norms for each item, sectorwise, are given below:

A. TRANSPORT EQUIPMENT

Railway wagons

Consumption of ordinary steel has been indicated in the Technology Report for Wagon Manufacturing Plant. For the manufacture

Appendix 6-5 (continued)

of 100 four-axle wagons (8-wheelers), steel requirement would amount to 1,080 tons, that is 10.8 tons per 8-wheeler wagon, which agrees well with the consumption norm in Indian practice. The breakdown of ordinary steel requirement by product categories according to the material balance sheet given in the Technology Report is given below:

Product category	Consumption per wagon (8-wheeler) kg
Beams	552
Channels	2 979
Angles	236
Tees	25
Total structural	3 792
Plates	5 633
Hot rolled strip/sheet	250
Total plates and sheets	5 883
Bars and rods	1 075
Pipes and tubes	50
Grand total ..	10 800

Trailers

From the materials balance given in the Technology Report, the following norms have been evolved:

Product category	Consumption per trailer kg
Channels	860.0
Angles	1 000.0
Plates	98.5
Hot rolled strip/sheet	[illegible]
Total ..	[illegible]

Appendix 6-5 (continued)

Buses and mini-buses

According to information obtained from the manufacturers, the consumption of ordinary steel for buses and mini-buses is as follows:

Buses

Manufacturer	No of buses	Ordinary steel consumption/unit kg
Iran National	1 200	2 900
Iran Peyma	65	3 050
Pars-lux	144	2 700
Industrial Auto-bus Consortium ..	210	3 000

Weighted average consumption per unit of production

$$= \frac{1\,200 \times 2\,900 + 65 \times 3\,050 + 144 \times 2\,700 + 210 \times 3\,000}{1\,200 + 65 + 144 + 210} = 2\,950 \text{ kg}$$

Mini-buses

Manufacturer	No of buses	Ordinary steel consumption/unit kg
Iran National	2 400	1 650
Iran Peyma	15	1 600
Pars-lux	16	1 650
Industrial Auto-bus Consortium ..	73	1 700

Weighted average consumption per unit of production

$$= \frac{1\,650 \times 2\,400 + 1\,500 \times 15 + 16 + 1\,650 \times 16 + 1\,700 \times 73}{2\,400 + 15 + 16 + 73} = 1\,680 \text{ kg}$$

The combined consumption norm for buses and mini-buses can be determined on weight basis of consumption for each.

Appendix 6-1 (continued)

As no indigenous production capacity is envisaged before 1975, forecasts for 1977 and 1982 only were taken into consideration, and the estimated demand of umbrella ribs will be 250,000 and 300,000 Nos respectively.

Wire netting and wire products

The requirement of wire netting and wire products in countries of the level of development of Iran is about 15 per cent of the total wire requirement. On the basis the requirement for wire netting and wire products would be 2,080, 3,112 and 6,400 tons for the years 1972, 1977 and 1982 respectively.

Forecast by other methods

ACSR core wire

Steel wire core is used for reinforcing the aluminium conductor used for power transmission. Transmission line programme indicated by the Ministry of Water and Power are as follows:

Year	Location	Length of line km	Aluminium required a/ tons
1972	Rezasah - Teheran	150	450
	Rezasah - Ahwaz	550	1 650
		700	2 100
1977	Isfahan - Teheran	430	1 290
	Rezasah - Arak	275	825
	Arak - Teheran	275	825
	Arak - Teheran	275	825
	Rezasah - Kasu	35	105
		1 290	3 870
1982	Rezasah - Teheran	550	1 650

Source: Ministry of Water and Power, Government of Iran.

a/ Aluminium required is 3 tons per kilometre.

Appendix 6-5 (continued)

Buses		Mini-buses		Weighted average for all production
Production	Consumption	Production	Consumption	
No	kg	No	kg	kg
1 619	2 950	2 504	1 680	$\frac{2\ 950 \times 1\ 619 + 2\ 504 \times 1\ 680}{2\ 504 + 1\ 619}$
				= 2 200

Allowing 15% for wastage $= \frac{2\ 200}{0.85}$ = 2 590 kg

The breakdown of consumption by product categories according to the information received from the manufacturers referred to is as follows:

Product category		Consumption per unit kg
Angles	..	60
Plates	..	500
Cold rolled strip/sheet	..	1 500
Hot rolled strip/sheet	..	100
Galvanised sheets	..	80
Bars and rods	..	250
Pipes and tubes	..	100
Total	..	2 590

Cars

Norms for passenger cars were derived from data obtained from the manufacturers. These are as follows:

Manufacturer		Production No	Steel consumption per unit a/ kg
Sharkate Sahami Jeep Co	..	5 000	1 300
Iran National	..	19 500	650

a/ Includes wastage @ 40%.

Appendix 6-5 (continued)

The weighted average of consumption

$$= \frac{5\ 000 \times 1\ 300 + 19\ 500 \times 650}{24\ 500} = 794 \text{ kg}$$

Trucks

Trucks are manufactured by Leyland and Kareigh. No information was available from Kareigh. Unit consumption for trucks was calculated on the basis of information from Leyland only. Leyland is now manufacturing three types of trucks which are representative of the common types in use now and which are likely to continue to be used in future in Iran. Therefore, the unit consumption derived from the three types of trucks manufactured by Leyland may be assumed as representing a realistic consumption norm for trucks.

Type of truck		Production No	Consumption/truck kg
Super Comet	..	1 200	2 250
Super Hippo	..	250	2 000
Triumph Pony	..	1 000	1 450

The weighted average of consumption

$$= \frac{2\ 250 \times 1\ 200 + 2\ 000 \times 250 + 1\ 450 \times 1\ 000}{1\ 200 + 250 + 1\ 000} = 1\ 870 \text{ kg}$$

The breakdown of unit consumption by product categories as per Leyland's practice is as follows:

Product category		Consumption per unit kg
Channels	..	30
Angles	..	50
Tees	..	10
Plates	..	500
C.R. sheets/strip	..	1 000
H.R. sheets/strip	..	50
Galvanised	..	50
Bars and rods	..	150
Pipes and tubes	..	30
Total	..	1 870

Appendix 6-5 (continued)

Jeeps, station wagons, ambulances and vannets

The unit consumption for jeep, station wagon and vannet is lower than that in other countries as aluminium is used extensively for chassis panels. Aluminium is used to the extent of approximately 40 per cent. As a result, the average steel consumption per unit in other countries is 900 kg, whereas in Iran it is about 540 kg. Land Rover Company are actually using 537 kg,and this unit consumption figure was adopted. The breakdown of 537 kg by product categories is given below:

Product category	Consumption per unit kg
Plates	15
Cold rolled sheet	400
Hot rolled sheet	60
Wires	2
Bars and rods	25
Pipes and tubes	35
Total	537

Motor cycles, scooters and mopeds

Motor cycles, scooters and mopeds are not manufactured at present in Iran and no norms could therefore be determined on the basis of field survey. However, there are plans for their production in Iran in future. As the production programmes for motor cycles, scooters and mopeds will change, the combined norms of consumption will be different for the periods under purview. The norms of consumption thus calculated are as follows:

Appendix 6-5 (continued)

Product category		Consumption per unit 1972 kg	1977 kg	1982 kg
Plates ..	..	6.2	6.0	5.8
Cold rolled sheet/strip	..	26.4	26.0	25.5
Hot rolled sheet/strip	..	3.6	3.5	3.5
Wires ..	..	0.6	0.5	0.5
Bars and rods ..	..	5.3	5.2	5.0
Pipes and tubes	..	4.9	4.8	4.7
Total	..	47.0	46.0	45.0

Automobile ancillaries

In collaboration with Mitsubishi, Japan, Iran is contemplating to set up an automobile ancillary plant. The items to be manufactured include self-starter, horn-relay, sparking plugs, shock absorber, carburettor etc. The total value of automobile ancillaries manufactured will be 150 million Rials in 1972 and ordinary steel requirement will be 808.5 tons. This gives a requirement of 5.39 ton/million Rials. According to the material list given by Mitsubishi, the breakdown by categories is as follows:

Product category		Consumption per million Rials kg
Plates ..	..	3 700
Cold rolled sheet/strip	..	400
Hot rolled sheet/strip	..	520
Galvanised sheets	..	510
Bars and rods	..	160
Pipes and tubes	..	100
Total	..	5 390

Appendix 6-5 (continued)

Vehicular diesel engine

The manufacture of diesel engines for buses, mini-buses and trucks will be undertaken in plants being set up in Tabriz by the two leading manufacturers - Dorman and Leyland. The unit consumption of steel according to information furnished by these firms is given below:

Product category		Consumption per unit kg
Angles ..	..	6
Plates ..	..	180
Cold rolled sheet/strip	..	2
Hot rolled sheet/strip	..	30
Bars and rods ..	..	22
Pipes and tubes ..	..	3
Total	..	243

Bicycles complete

At present there is no manufacturer in Iran of complete bicycles. There are only some assembly shops. No detailed norms by categories could be obtained, but as bicycles in general differ little from country to country, Indian norms were adopted as fairly representative. The unit consumption of steel for bicycles is as follows:

Product category		Consumption per unit kg
Cold rolled sheet/strip	..	8.6
Hot rolled sheet/strip	..	0.9
Wire ..	..	2.0
Bars and rods ..	..	7.5
Pipes and tubes ..	..	4.2
Total	..	23.2

Appendix 6-5 (continued)

B. ELECTRICAL EQUIPMENT

Electric transformers

Consumption figures were obtained from Siemens and Iran Transfo. These were compared with Indian norms and suitably adjusted in accordance with the manufacturing programme of big transformers. The unit consumption per 1,000 kVA thus derived is given below:

Product category	Consumption per unit kg
Beams	14.0
Channels	250.0
Angles	130.0
Plates	477.0
Hot rolled sheet/strip ..	116.0
Bars and rods	69.0
Pipes and tubes ..	325.0
Total ..	1 381.0

Electric motors

There is no manufacture of electric motors in Iran at present. On the basis of consumption by Indian manufacturers as well as information furnished by the Research Centre, the consumption per 1,000 kW is given below:

Product category	Consumption per unit kg
Cold rolled sheets/strip ..	500.0
Hot rolled sheets/strip ..	156.0
Bars and rods ..	710.0
Total ..	1 366.0

Appendix 6-5 (continued)

Switchgear and control gear

The consumption per million Rials of domestic input, which implies the amount envisaged as likely indigenous production, was calculated from the information given by Siemens Company. These are as follows:

Product category	Consumption per unit kg
Channels	120
Angles	300
Plates	250
Cold rolled sheets/strip ..	1 750
Bars and rods	450
Pipes and tubes	350
Total ..	3 220

Transmission towers

This is a fabricated item. Taking approximate wastage of 10 per cent, the net requirement of steel is 1,100 kg per ton of fabrication.

The breakdown of consumption per ton of tower was made on the basis of Indian practice and is given below:

Product category	Consumption per unit kg
Channels	50
Angles	950
Plates	25
Bars and rods	75
Total ..	1 100

Appendix 6-5 (continued)

House service meters

This is not manufactured in Iran at present. From the information obtained from Indian manufacturers, the consumption per 1,000 numbers is as follows:

Product category		Consumption per unit kg
Cold rolled sheet/strip	..	1 000
Bars and rods ..	..	60
Total	..	1 060

Electric fans

Based on Indian practice and taking into consideration substitution to a certain extent by plastics, the consumption per fan is as follows:

Product category		Consumption per unit kg
Cold rolled sheet/strip	..	0.1
Hot rolled sheet/strip	..	2.6
Wire ..	..	0.4
Bars and rods ..	..	1.5
Pipes and tubes	..	0.4
Total	..	5.0

Air coolers

The consumption of steel per air cooler obtained from the two leading manufacturers, Asmayesh and Ars Corporation, is as follows:

Manufacturer		Production No	Unit consumption[a/] kg
Asmayesh	..	25 000	24
Ars Corporation	..	53 000	24

a/ Includes wastage.

Appendix 6-5 (continued)

Airconditioners

Airconditioners are not being produced in Iran at present. The norm of consumption evolved is based on that of two leading manufacturers in India. Taking into consideration the possible diversification of product sizes, the norms of consumption have been suitably modified as shown below for the three periods:

Product category	Consumption per unit 1972 kg	1977 kg	1982 kg
Channels	4.5	6.75	11.25
Angles	7.5	11.25	18.75
Tees	3.0	4.50	7.50
Cold rolled sheet/strip ..	47.5	71.25	118.75
Galvanised sheet/strip ..	9.0	13.50	22.50
Bars and rods	7.5	11.25	18.75
Pipes and tubes	1.0	1.50	2.50
Total	80.0	120.00	200.00

Refrigerators (domestic and commercial)

The unit consumption was derived from the data furnished by two major manufacturers.

Manufacturer	Production No	Unit consumption kg
Asmayesh ..	75 000	67
Philver ..	20 000	64
Zargross		
Freezer ..	1 800	64
Splaylax ..	3 000	78

The weighted average of consumption

$$= \frac{75\ 000 \times 67 + 20\ 000 \times 64 + 1\ 800 \times 64 + 3\ 000 \times 78}{75\ 000 + 20\ 000 + 1\ 800 + 3\ 000} = 65 \text{ kg}$$

Appendix 6-5 (continued)

The categorywise breakdown of steel consumption per refrigerator is given below:

Product category		Consumption per unit kg
Cold rolled sheets/strip	..	59.0
Wires ..	..	2.0
Bars and rods ..	..	1.0
Pipes and tubes	..	3.0
Total	..	65.0

Water coolers

The norm of consumption per water cooler was determined on the basis of field survey data as follows:

Product category		Consumption per unit kg
Angles ..	..	3.8
Cold rolled sheets/strip	..	13.3
Galvanised sheets	..	21.0
Bars and rods ..	..	0.2
Pipes and tubes	..	1.7
Total	..	40.0

Water heaters

The consumption per water heater was determined from the figures reported by two leading manufacturers as follows:

Manufacturer	Production No	Unit consumption kg
Asmayesh ..	18 000	10
Iran Gas Company	4 000	8.8

The weighted average of consumption

$$= \frac{18\ 000 \times 10 + 4\ 000 \times 8.8}{22\ 000} = 10 \text{ kg}$$

10 kg is comprised of 9 kg cold rolled sheet and strip, 1 kg wire.

Appendix 6-1 (continued)

The ratio of steel to aluminium in ACSR conductor is generally 30:70. Steel core wire requirement will therefore be as follows:

Year	Aluminium tons	Steel a/
1972	2 100	900
1977	3 870	1 660
1982	2 350	1 010

a/ Including process loss @ 30%

As no capacity for conductor manufacture is envisaged by 1972, the forecasts for 1977 and 1982 only were considered.

Storage tanks

Tanks are mainly used for storage of oil and oil products and water.

Oil and oil products: According to information obtained from the National Iranian Oil Company (NIOC) the increase in oil refinery capacity between 1969 and 1980 will be 21.5 million tons, an average increase of 2 million tons per year. NIOC is contemplating to install either a 60,000 barrel per day refinery every 2 years or a 90,000 barrel per day refinery every 3 years.

A 40,000 barrel per day reviery, requiring storage capacity for two montns duration, would consume about 10,000 tons of steel for storage tanks. On the basis of the same storage capacity/period, 60,000 barrels and 90,000 barrels per day refineries will require

Appendix 6-5 (continued)

Radio receivers and television sets

Japanese and European radio receivers and television sets are mostly used in Iran today. No facilities exist for manufacture, but a few units are engaged in building the bodies of the sets. However, there are definite plans for manufacturing complete sets in Iran in the near future. The norms of consumption for radio receivers and television sets based on Japanese and European practices are as follows:

Product category		Radio receivers kg/'000 Nos	Television set kg/'000 Nos
Cold rolled sheet/strip	..	250	375
Wires ..	..	150	-
Bars and rods ..	..	20	50
Total	..	420	425

P.A. system, electric and electronic equipment

None of these items are manufactured in Iran at present. Consumption norms based on the practices of developing countries like India are given below:

Product category		P.A. system kg/mill. Rials	Electric and Electronic equipment kg/mill. Rials
Channels ..	..	180	-
Angles ..	..	680	-
Cold rolled sheet/strip	..	715	750
Galvanised sheets	..	7	-
Wires ..	..	16	-
Bars and rods ..	..	185	50
Total	..	1 783	800

Appendix 6-5 (continued)

Electrical conductor (ACSR)

Steel core for reinforcing the aluminium conductor used for electrical transmission and distribution amounts to 300 kg per ton of conductor (ACSR).

INDUSTRIAL AND AGRICULTURAL MACHINES

Tea processing machines, weighing machines

The consumption norms for tea processing machines and weighing machines were determined on the basis of information obtained from manufacturers in Iran as well as in India. It may be assumed that the price of the finished product will be 70 Rials per kg. So, per million Rials of output the total quantity of finished product will be 14,410 kg, out of which 280 kg is alloy steel. So the tonnage steel will be 14,130 kg.

Product category		Tea processing machines kg/mill. Rials	Weighing machines kg/mill. Rials
Beams ..	..	-	180
Channels ..	..	141	[illegible]
Angles ..	..	400	[illegible]
Plates ..	..	10 [illegible]	[illegible] 000
Cold rolled sheet/strip	..	-	[illegible]
Hot rolled sheet/strip	..	1 [illegible]	[illegible]
Galvanised sheets	..	141	-
Bars and rods ..	..	1 [illegible]	[illegible]
Pipes and tubes	..	[illegible]	[illegible]
Total	..	14 130	[illegible]

Appendix [illegible] (continued)

[illegible]

Based on the material list furnished by [illegible] Tractor Plant which is now under construction, the consumption per tractor was determined by us as follows:

Finished steel		Consumption per unit kg
Channels	..	[illegible]
Angles	..	10
Plates	..	60
Cold rolled sheet/strip	..	[illegible]
Hot rolled sheet/strip	..	80
Wire	..	[illegible]
Bars and rods	..	[illegible]
Pipes and tubes	..	[illegible]
Total		[illegible]

[illegible]

The material list furnished by [illegible] Building Plant was taken as the basis for calculating the norms of consumption per million [illegible] of [illegible] production. The norms thus arrived were compared with norms obtained in Indian practice and the final norms adopted after suitable adjustment.

Finished steel		Consumption per unit
Plates	..	[illegible]
Bars and rods	..	[illegible]
Total	..	[illegible]

[illegible]

On the basis of practices obtaining in similar developing countries, the norms of consumption adopted are as follows:

Appendix 6-5 (continued)

Product category	Crawler tractor kg/No	Building and road construction machinery kg/mill. Rials
Channels	-	2 491
Angles	-	1 835
Plates	3 000	3 018
Cold rolled sheet/strip ..	500	3 607.5
Hot rolled sheet/strip ..	250	3.5
Bars and rods	250	980
Pipes and tubes	100	65
Total ..	4 100	12 000

Stationary diesel engines and cranes

The Tabriz Metallurgical and Engineering Plant is contempla-ting to produce stationary diesel engines and cranes. The norms of consumption per number of diesel engine and per ton of crane on the basis of information obtained during discussions with concerned authorities are given below:

Product category	Stationary diesel engines kg/No	Cranes kg/ton
Beams	-	40
Channels	-	2[illegible]7
Angles	1	290
Tees	-	4
Plates	-	78
Hot rolled sheet/strip	30	15.5
Wires	1	1.5
Bars and rods	66	114
Pipes and tubes	2	10
Total ..	100	810

Appendix 6-5 (continued)

Passenger and industrial lifts, fork lifts, other material handling equipment and industrial boilers

In case of other material handling equipment assuming 78 Rials per kg of finished product, 60 per cent as the tonnage steel content and 14 per cent as the process loss, the norms of consumption will be 8,778 kg, say 9,000 kg per million Rials. As there are no manufacturers of the other items in Iran, the norms of consumption for each of these items are derived on the basis of consumption figures obtained in other developing countries.

Product category		Passenger lifts kg/No	Industrial lifts kg/No	Fork lifts kg/No	Other material handling equipment kg/mill.Rials	Industrial boilers kg/mill.Rials
Beams ..	..	114	330	-	235	-
Channels ..	..	114	330	7	783	-
Angles ..	..	242	700	27	1 407	100
Tees ..	..	-	-	-	-	-
Plates ..	..	138	400	400	2 662	4 000
C.R. sheet/strip	..	128	370	-	1 566	-
H.R. sheet/strip	..	66	190	25	-	-
Galvanised sheet	..	197	570	-	-	-
Wires ..	..	1	2	-	-	-
Bars and rods	..	-	-	45	470	100
Pipes and tubes	..	-	-	-	1 877	3 300
Total	..	1 000	2 892	504	9 000	7 500

Air compressors and power driven pumps

The Tabriz Metallurgical and Equipment Plant is contemplating manufacture of compressors and pumps. The norms of consumption have been derived from the production programme and material balance of Tabriz Metallurgical and Engineering Plant.

Appendix 6-5 (continued)

Product category	Air compressors kg/mill. Rials 1972	1977	1982	Power driven pumps kg/No
Angles ..	18.15	22.0	27.50	-
Plates ..	244.25	296.0	370.00	-
H.R. sheets/strip	6.60	8.0	10.00	-
Bars and rods ..	195.50	237.0	296.25	15
Pipes and tubes ..	195.50	237.0	296.25	6
Total ..	660.00	800.0	1 000.00	21

Textile, sugar and cement machinery and equipment for chemical industry

On the basis of data furnished by the Research Centre, Ministry of Economy, Iran and information obtained from Indian manufacturers, the consumption norms calculated are as follows:

Product category	Textile machinery kg/million Rials	Sugar machinery kg/million Rials	Cement machinery kg/million Rials	Equipment for chemical industry kg/ton
Beams	412	800	850	26.0
Channels	217	800	300	28.0
Angles	313	400	430	20.0
Tees	-	-	-	4.0
Plates	3 125	4 000	6 000	380.0
C.R. sheets/strip ..	73	150	570	150.0
H.R. sheets/strip ..	83	-	-	18.8
Galvanised sheets ..	-	5	15	0.2
Wires	625	-	-	-
Bars and rods ..	1 250	600	1 000	135.0
Pipes and tubes ..	610	900	600	38.0
Total ..	6 708	7 655	9 765	800.0

Appendix 6-5 (continued)

Heavy plate and vessels (reactor vessels, columns and towers)

The norms of consumption per ton were determined on the basis of material list furnished by the Research Centre, Ministry of Economy. After making allowance for normal wastage of about 10 per cent during fabrication, the total weight of plate required is 1,100 kg per ton of finished product.

Machine tools and machine tool accessories

On the basis of the production programme of Tabriz Metallurgical and Engineering Plant and their steel requirements excluding castings, the norms of consumption per million Rials were estimated.

Product category	Machine tool kg/mill. Rials	Machine tool accessories kg/mill. Rials
Beams	15	-
Channels ..	15	-
Angles	200	-
Tees	-	-
Plates	400	-
C.R. sheets/strip	45	-
H.R. sheets/strip	60	-
Wires	30	-
Bars and rods ..	290	4 000
Pipes and tubes ..	300	-
Total ..	1 355	4 000

Hand tools

The consumption norm per ton derived on the basis of the consumption pattern of Indian manufacturers is 1,120 kg per ton, of which 870 kg is ordinary steel bars and rods and 250 kg is alloy constructional steel.

Appendix 6-5 (continued)

Dumpers and scrapers, shovels and excavators and road rollers

On the basis of practices in developing countries, the following consumption norms were adopted for estimating the steel requirement for the production anticipated in future years.

	Dumpers and scrapers kg/No	Shovels and excavators kg/No	Road rollers kg/No
Beams	50	-	-
Channels	200	-	100
Angles	150	-	50
Plates	5 500	18 000	6 500
C.R. sheets/strip ..	2 500	-	-
H.R. sheets/strip ..	-	1 500	80
Bars and rods	200	1 500	480
Pipes and tubes	-	1 000	60
Total ..	8 600	22 000	7 270

Dairy machinery

From information given by the Research Centre, Ministry of Economy, the following consumption norms were evolved:

	kg/mill. Rials
Channels	350
Angles	70
Plates	180
C.R. sheets/strip ..	1 200
Bars and rods	110
Pipes and tubes ..	50
Total	1 960

Appendix 6-5 (continued)

METAL PRODUCTS

Steel furniture, steel wire ropes, expanded metal, bolts, nuts and rivets, builders hardware and tanks

These are all fabricated items. Steel requirement for each is calculated on the basis of wastage per cent. The average wastage per cent for these items and corresponding steel requirement are indicated below:

	Wastage %	Steel required kg/ton product
Steel furniture ..	10	1 113
Steel wire ropes ..	9	1 100
Expanded metal ..	9	1 100
Bolts, nuts and rivets	30 - 35	1 500 a/
Builders hardware b/ ..	20	600 c/
Tanks	10 - 15	1 150 d/

a/ In determining total steel requirement, allowance of 33 per cent was made for wastage.

b/ About 50 per cent of builders' hardware used in Iran is made of brass and aluminium, the remaining 50 per cent being steel.

c/ With 20 per cent wastage, the total metal requirement is 1,200 kg per ton of builders' steel hardware. As the proportion of steel hardware is only 50 per cent of the total, the net steel requirement is 600 kg per ton of total builders hardware.

d/ The average wastage is taken as 13 per cent.

Gas cylinders

From the consumption figures of Karkhanejate Oilgas Limited and Bootan Gas Co, the consumption norm per gas cylinder was determined.

Appendix 6-5 (continued)

Manufacturer	Production Nos	Unit consumption kg
Karkhanejate Oilgas	90 000	22.0
Bootan Gas	40 000	17.7

Weighted average

$$= \frac{90\ 000 \times 22 + 40\ 000 \times 17.7}{130\ 000} = 20 \text{ kg}$$

		Unit consumption kg
comprising	C.R. sheets/strip	18
	Bars and rods	1
	Pipes and tubes	1
	Total ..	20

Wire nails, wood and machine screws, wire netting and wire products

On the basis of scrap losses incurred in manufacture of these items, the steel requirements are as follows:

Wire nails, wood and machine screws ..	1 080 kg/ton
Wire netting and wire products ..	1 100 kg/ton

Stoves

On the basis of information received from Tedou Co and Zeh Co, the unit consumption per stove was calculated as follows:

Manufacturer		Production No	Unit consumption kg
Tedou Co		9 000	12
Zeh Co	large	9 000	25
	small	25 000	17

Appendix 6-1 (continued)

respectively 15,000 tons and 22,500 tons of steel. If the storage capacity/period is reduced, the steel requirement for tanks will also be correspondingly less. Taking one month's production as storage requirement the storage capacity will be 11,250 tons for a 90,000 barrel/day refinery. Steel requirement per year will be 3,750 tons on the assumption that a 90,000 barrel/day refinery will be installed every three years. As NIOC's requirement represents 60 to 65 per cent of the total, the total steel requirement for storage tanks of oil refineries would be 5,700 tons.

Gas: According to information given by National Iranian Gas Co. the requirement of steel for gas storage holders would be 600 tons for 1972. Taking National Iranian Gas Company's requirement as 55 per cent of the total, the total requirement will be 1,100 tons per annum.

Water: Two tank manufacturing units which meet 70 per cent of the water tank requirements in Iran were contacted. According to their estimates steel requirements for tank manufacture by 1972 would be 1,800 and 2,500 tons respectively, that is a total of 4,300 tons. As this would represent about 70 per cent of the total steel requirement may be placed at 6,200 tons.

Tanks for other uses: For storing other products like edible oils, cotton seed oil etc, the requirement of tanks has been assumed as 10 per cent of the total.

Appendix 6-5 (continued)

Weighted average

$$= \frac{9\ 000 \times 12 + 9\ 000 \times 25 + 25\ 000 \times 17}{43\ 000} = 18 \text{ kg}$$

The break-down is as follows:

	kg
C.R. sheets/strip	15
Bars and rods	3
Total	18

Sewing machines, typewriters and office machines

These items are not now made in Iran. On the basis of Indian practice, the norms are as follows:

	Sewing machines kg/No	Typewriter and office machines kg/No
Plates ..	0.1	-
C.R. sheets/strip ..	1.0	14.5
H.R. sheets/strip ..	1.0	-
Bars and rods ..	3.5	3.5
Total ..	5.6	18.0

Steel drums and containers, tin cans, arc welding electrodes, windows and door frames, heavy pipes and tubes

Except for arc welding electrodes, the items mentioned above are all fabricated products. The gross steel requirement should therefore allow for loss during fabrication. In case of arc welding electrodes, the ratio of the weight of flux coating to that of the steel core is the basis for calculating the steel rod requirement. The wastages and the gross steel requirements are as follows.

Appendix 6-5 (continued)

	Wastage %	Steel requirement kg/ton product
Steel drums and containers	20	1 270
Tin cans	9	1 100
Arc welding electrode ..	25	700
Windows and door frames ..	10	1 103
Heavy pipes and tubes ..	15 - 20 a/	1 200

a/ Average wastage taken for assessing the steel requirement is 17 per cent.

Construction

Steel structural frame method is widely adopted for building construction in Iran. Reinforced concrete is used to a limited extent, mostly for construction of government buildings. From discussions with leading contractors, consultants etc, it was ascertained that at present 26 kg of steel per sq metre is used for structural frame buildings and 6 kg for r.c. construction. In keeping with the trend towards increased adoption of r.c. construction for non-industrial buildings, different norms of consumption have been used for 1972, 1977 and 1982. This variation in norms is called for only in case of non-industrial building construction. In respect of other constructional activities norms varying over a period of time are not considered necessary as construction methods and steel consumption norms are not expected to change radically. Steel consumption norms in kilograms per million Rials of investment in constructional activities other than non-industrial building construction are given in Table 6-5-1.

Appendix 6-5 (continued)

Table 6-5-1

STEEL CONSUMPTION NORMS FOR CONSTRUCTIONAL ACTIVITIES OTHER THAN NON-INDUSTRIAL BUILDINGS

kg/million of Rials

	Large and medium industries/ mining	Agricul- ture and allied activities	Oil and gas	Irri- gation	Roads/ build- ings	Tele- vision	Airports	Ports/ harbours
Beams ..	800	400	199	900	500	125	55	1 400
Channels ..	900	700	399	150	80	3 700	33	500
Angles ..	1 400	350	399	225	350	2 000	140	3 500
Tees ..	-	25	25	15	-	-	-	2 200
Plates ..	800	25	99	1 100	-	-	-	3 500
C.R. sheets/strip	-	-	-	30	-	-	-	-
H.R. sheets/strip	700	15	10	75	400	7 000	170	-
Galvanised sheets	1 500	945	50	300	1 250	1 000	550	4 600
Bars and rods ..	160	1 500	314	5 725	9 600	10 675	4 500	9 200
Pipes and tubes	240	1 500	55	-	-	-	-	-
Total ..	6 500	5 460	1 550	7 520	12 180	24 500	5 448	24 900

Appendix 6-5 (continued)

Housing and other non-industrial buildings

For non-industrial buildings, the gradual change over from structural steel frame to r.c. construction is expected to be more or less complete by 1982. Therefore, for 1982, r.c. construction norm of 6 kg of steel per sq m was adopted. Even by 1972 it is anticipated that there will be a pronounced increase in r.c. buildings and consequently the norm will change from 26 kg/sq m for structural steel frame construction to an average of 11 kg of steel/sq m, and by 1977 it would be 9 kg/sq m. On the basis of these assumptions, the norms of consumption per million Rials of total outlay on housing and other non-industrial buildings were calculated and are given below:

		Steel per million Rials outlay		
		[illegible]	[illegible]	[illegible]
		kg	kg	kg
Beams ..	..	13 [illegible]00	8 000	3 000
Channels ..	..	1 500	1 000	500
Angles ..	..	500	350	200
Tees ..	..	50	50	50
H.R. sheets/strip	..	250	250	250
Galvanised ..	..	1 000	1 000	800
Wires ..	..	110	100	100
Bars and rods	..	50	2 600	4 300
Pipes and tubes	..	1 800	2 000	2 200
Total	..	[illegible]	[illegible]	[illegible]

Rail transport

Steel consumption norms for railways based on information given in Hawley Wagon Report and the practices followed in India are given in Table 6-5-8.

Appendix 6-6 (continued)

Table 6-6-2

REQUIREMENT OF STEEL MATERIALS FOR RAILWAYS

Tons/km

	Rails	Fish plates	Fish bolts	Sleepers a/	Dog spikes b/	Points and crossings c/	Total
New broad gauge line ..	80	4	1	77	1.5	3.5	167

	Beams	Channels	Angles d/	Tees d/	Plates	Sheet coil	Bars/rods	Wires	Pipes/tubes	Total
Electrification ..	17	6	4.2	[illegible].8	0.8	[illegible].06	7.0	0.5	1.0	40.66
Signalling and safety units ..	[illegible]	[illegible]	[illegible].57	[illegible]	3.0	3.[illegible]	3.0	9.0	1.5	20.70

a/ Sleepers refer to steel sleepers. The number of sleepers required per kilometre of track is 1,[illegible], each sleeper weighing approximately 60 kg.

b/ Dog spikes are fasteners for fixing the track on wooden sleepers which are used for special purposes.

c/ Points and crossing is taken as 4 per cent of the weight of rails.

d/ Of the total requirement of angles and tees, angles constitute [illegible] per cent.

Appendix 6-3 (continued)

Power supply

For determination of steel requirement, the entire power generation and supply system is considered under the following heads:

1. Generation

   a) Hydel
   b) Thermal

2. Transmission

   a) 400 kV
   b) 220 kV
   c) 132 kV

3. Distribution

The consumption norms were derived on the basis of information obtained from the Ministry of Water and Power on the programme under each head and the corresponding steel requirements. The norms are given in [illegible] Annex.

[illegible]

[illegible]

Appendix 6-6

NOTES ON CONSUMPTION NORMS FOR ALLOY STEELS

The methods adopted for evaluation of consumption norms of ordinary steel for each consuming item are discussed in appendix 6-5. The same methodology has been adopted for alloy steels also. The basis of determination of norms adopted for various alloy and special steel consuming items are indicated below and the consumption norms are given in appendix 6-8.

Item		Basis of norms evolution
a. Transport equipment		
Vehicular petrol engine	-	Information obtained from Iran National, cross checked with Indian practice
Railway wagons (8-wheeler)	-	Hamvley Wagon Report - materials balance
Trailers	-	-do-
Buses and mini-buses	-	Field survey
Cars	-	"
Trucks	-	"
Jeeps, station wagons, ambulances and vanetts	-	"
Motor cycles, scooters and mopeds	-	Information supplied by Research Centre
Automobile ancillaries	-	Information furnished by a Japanese firm to the Research Centre

Appendix 6-6 (continued)

Item		Basis of norms evolution
Vehicular diesel engine	-	Dorman-Leyland project - materials balance
Bicycles complete	-	Indian practice
Auto leaf springs	-	Average processing scrap loss incurred during manufacture
B. Electrical equipment		
Electric transformers	-	Indian practice
Electric motors	-	"
Switchgear and control gear	-	"
House service meters	-	"
Electric fans	-	"
Airconditioners	-	"
Refrigerators (domestic and commercial)	-	Weighted average of the consumption norms of existing manufacturers
Radio receivers	-	Japanese norms
P.A. system	-	Indian practice
Electric and electronic equipment	-	Report prepared by the Research Centre
C. Industrial and agricultural machinery		
Agricultural tractors	-	Materials balance of Tabriz Tractor Plant
Agricultural implements	-	Materials balance of Arak Machine Building Plant and Indian practice
Crawler tractors	-	Indian practice
Building & road construction machinery	-	"
Stationary diesel engines	-	Materials balance of Tabriz Metallurgical and Engineering Plant
Cranes	-	Materials balance of Arak Machine Building Plant
Passenger & industrial lifts	-	Indian practice
Fork lifts	-	"
Other material handling equipment	-	Materials balance of Arak Machine Building Plant

Appendix 6-6 (continued)

Item		Basis of norms evolution
C. **Industrial and agricultural machinery** (cont'd)		
Industrial boilers	-	Indian practice
Air compressors	-	Materials balance of Tabriz Metallurgical and Engineering Plant
Power driven pumps	-	"
Textile machinery	-	Information given by the Research Centre, cross checked with Indian practice
Sugar machinery	-	"
Cement machinery	-	"
Equipment for chemical industry	-	"
Machine tools	-	Materials balance of Tabriz Metallurgical and Engineering Plant
Machine tool accessories	-	"
Hand tools	-	Field survey information
Dumpers and scrapers, shovels and excavators	-	Indian practice
Road rollers	-	"
Dairy machinery	-	Information given by the Research Centre, cross checked with Indian practice
Weighing machines	-	"
Tea processing machinery	-	Field survey data and Indian practice
Small tools	-	Indian practice
D. **Metal products**		
Bolts, nuts and rivets	-	Field survey data and Indian practice
Sewing machines	-	Indian practice
Arc welding electrodes	-	Weighted average value of the ratio of flux weight to total core weight as given by different manufacturers

Appendix 6-1 (continued)

Total steel requirement for tanks will be as follows:

		1972	1977	1982
Oil	..	5 700	5 700	5 700
Gas	..	1 100	1 500	2 520
Water	..	6 200	7 510	10 325
Sub-total		13 000	14 710	18 545
Others at 25% of the above	..	3 250	3 675	4 630
Total		16 250	18 385	23 175
Say	..	16 200	18 380	23 180

Tin cans

For canning and packaging, the requirements of tinplate were estimated on the basis of the quantities of different products that need such packaging. Products that need tinplate packaging and the norms of tinplate consumption are given in Table 6-1-1. The details of tinplate requirement for different packaged products are given in Table 6-1-2.

Appendix 6-6 (continued)

Item		Basis of norms evolution
D. Metal products (cont'd)		
Razor blades	-	Information given by manufacturer
Utensils	-	Of the total utensils tonnage a certain percentage is of alloy steel. This percentage was derived from discussions with dealers in Iran
Sewing machine needles	-	Indian practice
Umbrella ribs	-	"
Wire nails, wood and machine screws	-	Discussion held with dealers
Steel furniture	-	Weighted average of consumption norms given by different manufacturers
Watches, clocks & time-pieces	-	Indian practice
Ball and roller bearings	-	"
Hacksaw blades	-	Information given by manufacturer

NORMS OF ORDINARY STEEL CONSUM

(all consumption figures in

Item		Unit		Structurals: Beams	Channels	Angles	Tees	Plates	
I. MANUFACTURED ITEMS									
A. Transport equipment									
1. Railway wagons (8-wheelers)	..	No.		552.0	2 979.0	236.0	25.0	5 635.0	
2. Trailers	..	No.		-	260.0	1 000.0	-	92.5	
3. Buses and mini-buses	..	No.		-	-	60.0	-	500.0	1
4. Cars	..	No.		-	-	-	-	10.0	
5. Trucks	..	No.		-	30.0	50.0	10.0	500.0	
6. Jeeps and station wagons, ambulances and vannets a/	..	No.		-	-	-	-	15.0	
7. Motorcycles, scooters & mopeds	..	No.	72	-	-	-	-	6.2	
			77	.	-	-	-	6.0	
			82	-	-	-	-	5.8	
8. Automobile ancillaries	..	Million Rials		-	-	.	-	3 700.0	
9. Vehicular diesel engines	..	No.		-	-	6.0	-	180.0	
10. Bicycles complete	..	No.		-	-	-	-	-	
B. Electrical equipment									
11. Electric transformers	..	1 000 MVA		14.0	250.0	150.0	-	477.0	
12. Electric motors	..	1 000 [illegible]		-	.	-	-	-	
13. Switchgear and control gear	..	Million Rials		-	120.0	800.00	-	250.0	1
14. Transmission towers including micro-wave towers	..	ton		-	50.0	950.0	-	25.0	
15. House service meters	..	1 000 No.		.	-	-	-		
16. Electric fans	..	No.		-	-	-	.	.	
17. Air coolers	..	No.		-	-	.	-	-	
18. Air conditioners	..	No.	72	-	4.50	7.50	3.0	-	
			77	-	6.75	11.25	4.50	-	
			82	-	11.25	18.75	7.50	.	
19. Refrigerators (domestic and commercial	..	No.		-	.	.	-	.	
20. Water coolers	..	No.		-	.	3.8	-	.	
21. Water heaters	..	No.		-	.	-	-	.	
22. Radio receivers	..	1 000 No.		-	-	-	.	.	
23. Television sets	..	1 000 No.		-	-	.	-	-	
24. P.A. system	..	Million Rials		-	180.0	680.0	.	-	
25. Electric and electronic equipment		Million Rials		-	-	-	.	-	
26. Electrical conductors (ACSR)	..	ton		.	.	-	-	.	
C. Industrial and agricultural machinery									
27. Tea processing machinery	..	Million Rials		.	141.0	692.0	-	10 345.0	
28. Weighing machines	..	Million Rials		150 0	350.0	380.0	.	2 000.0	
29. Agricultural tractors	..	No.		.	30.0	10.0	-	40.0	
30. Agricultural implements	..	ton		-	-	-	.	12.0	

SECTION 1

Appendix 6-7

ORDINARY STEEL CONSUMPTION

(…nsumption figures in kg)

	Tees	Plates	Plain sheets/strips Cold rolled	Hot rolled	Coated sheets Galvanised	Tinned	Wires	Bars/rods	Pipes/tubes	Total
.0	25.0	5 633.0	-	250.0	-	-	-	1 075.0	50.0	10 800.0
.0	-	92.5	-	527.5	.	-	.	-	-	1 880.0
.0	-	800.0	1 500.0	100.0	80.0	-	-	220.0	100.0	2 580.0
	-	10.0	600.0	60.0	-	-	7.0	112.0	5.0	794.0
.0	10.0	800.0	1 000.0	50.0	50.0	-	-	150.0	30.0	1 870.0
	-	15.0	400.0	60.0	-	-	2.0	25.0	55.0	557.0
	-	6.2	26.4	3.6	-	-	0.6	5.5	4.9	47.0
	-	6.0	26.0	3.5	.	-	0.5	5.2	4.8	46.0
	-	5.8	25.5	3.5	-	.	0.5	5.0	6.7	48.0
	-	3 700.0	400.0	520.0	510.0	-	-	160.0	100.0	5 390.0
0	-	180.0	2.0	30.0	-	.	-	22.0	3.0	248.0
	-	-	8.6	0.9	-	-	2.0	7.5	4.2	25.2
.0	-	477.0	-	116.0	-	.		60.0	325.0	1 281.0
	-	-	500.0	156.0	.	-	-	710.0	-	1 366.0
.00	-	250.0	1 750.0	-	-	.	-	480.0	250.0	3 220.0
.0	-	25.0	-	-	.	-	.	75.0	-	1 200.0
	-	.	1 000.0	.	-		-	60.0	-	1 060.0
	.	.	0.1	2.6	-	.	0.4	1.5	0.4	5.0
	-	-	24.0	-	.	.	-	-	-	24.0
50	3.0	-	47.50	.	9.0	.	-	7.50	1.0	80.0
.25	4.50	-	71.25	.	13.50	.	.	11.25	1.50	120.0
.75	7.50	-	119.75	.	22.50	.	-	18.75	2.50	200.0
	-	-	30.0	-	.	-	2.0	1.0	3.0	66.0
.8	-	-	13.3	21-0	-	-	-	0.2	1.7	40.0
	-	.	9.0	-	-	-	1.0	-	-	10.0
	.	-	250.0	-		-	180.0	20.0	-	480.0
	-	-	375.0	.	.	-	-	30.0	-	[illegible]
.0	-	-	715.0	.	7.0	-	16.0	195.0	-	1 [illegible]
	.	-	750.0	.	-	-	-	50.0	-	800.0
	-	.	.	-	-	.	300.0	-	-	300.0
.0	.	10 345.0	-	1 405.0	141.0	.	-	1 065.0	251.0	14 150.0
.0	.	2 000.0	900.0	220.0	.	-	-	2 300.0	-	5 470.0
.0	-	40.0	215.0	20.0	.		2.0	300.0	15.0	902.0
	.	12.0	.	-		-		1 200.0	-	1 219.0

TION

g)

...in sheets/strips: Cold rolled	Hot rolled	Coated sheets: Galvanized	Coated sheets: Tinned	Wires	Bars/rods	Pipes/tubes	Total
-	280.0	-	-	-	1 078.0	50.0	10 800.0
-	387.5	.	-	.	-	-	1 880.0
500.0	100.0	80.0	-	-	[illegible]	100.0	2 580.0
600.0	60.0	-	-	7.0	112.0	5.0	794.0
[illegible]00.0	50.0	80.0	-	-	150.0	30.0	1 670.0
400.0	60.0	-	-	2.0	75.0	55.0	537.0
26.4	3.6	-	-	0.6	5.5	4.9	47.0
26.0	3.5	.	-	0.5	5.2	4.8	46.0
25.5	3.5	-	.	0.5	5.0	4.7	45.0
400.0	520.0	510.0	-	-	160.0	100.0	5 380.0
2.0	30.0	-	.	-	72.0	3.0	265.0
8.6	0.9	-	-	2.0	7.5	4.2	25.2
-	116.0	-	.		60.0	376.0	1 231.0
500.0	186.0	.	-	-	710.0	-	1 366.0
750.0	-	-	.	.	680.0	250.0	3 220.0
-	-	.	-	.	75.0	-	1 300.0
[illegible]00.0	.	-		-	60.0	-	1 080.0
0.1	2.6	-	.	0.4	1.5	0.4	5.0
24.0	-	.	.	-	-	-	24.0
47.50	.	9.0		-	7.50	1.0	60.0
71.25	.	13.50	.	.	11.25	1.50	120.0
119.75		22.50	.	-	19.75	2.50	200.0
30.0	-	.	-	2.0	1.0	3.0	65.0
13.3	21.0	-	-	-	0.2	1.7	40.0
9.0	-	-	-	1.0	-	-	10.0
[illegible]80.0	-		-	150.0	20.0	-	480.0
[illegible]75.0	.	.	-	-	30.0	-	405.0
[illegible]15.0	.	7.0	-	16.0	[illegible]	-	1 [illegible]
[illegible]50.0	.	-	-	-	50.0	-	600.0
.	.	-	.	200.0	-	-	200.0
-	1 465.0	141.0		-	1 [illegible]	331.0	14 120.0
[illegible]00.0	990.0		-	-	2 400.0	-	5 970.0
[illegible]15.0	60.0	.		9.0	500.0	15.0	900.0
	-		-		1 [illegible]	-	1 210.0

Item	Unit	Structurals: Beams	Channels	Angles	Tees	Plates	r
C. Industrial and agricultural machinery (cont'd)							
31. Crawler tractors ..	No.	-	-	-	-	3 000.0	
32. Building & road construction machinery ..	Million Rials	-	2 491.0	1 836.0	-	3 018.0	3
33. Stationary diesel engine ..	No.		-	1.0	-	-	
34. Cranes ..	No.	40.0	257.0	290.0	4.0	78.0	
35a Passenger lifts ..	No.	114.0	114.0	242.0	-	138.0	
35b Industrial lifts ..	No.	330.0	330.0	700.0	-	400.0	
36. Fork lifts ..	No.	-	7.0	27.0	-	400.0	
37. Other material handling equipment (conveying machinery) ..	Million Rials	235.0	783.0	1 407.0	-	2 662.0	1
38. Industrial boilers ..	Million Rials	-	-	100.0	-	4 000.0	
39. Air compressors ..	Million Rials						
72		-	.	18.15	-	244.25	
77		-		22.00	-	296.00	
[illegible]		-	.	27.50		370.00	
40. Power driven pumps (centrifugal and turbine) ..	No.	-	.	-	-	-	
41. Textile machinery ..	Million Rials	412.0	217.0	313.0	-	7 125.0	
42. Sugar machinery ..	Million Rials	800.0	800.0	400.0	-	4 000.0	
43. Cement machinery ..	Million Rials	850.0	300.0	430.0	-	6 000.0	
44. Equipment for Chemical industry ..	ton	26.0	28.0	20.0	4.0	380.0	
45. Heavy plate and vessel works ..	ton	7.0	7.0	17.0	1.0	874.0	
46. Machine tools ..	Million Rials	15.0	18.0	200.0	.	11[illegible]	
47. Machine tool accessories ..	Million Rials	-	-	-	-	-	
48. Hand tools ..	ton	-	.	.	-		
49. Dampers and scrapers ..	No.	50.0	200.0	150.0	-	5 5[illegible].0	2
50. Shovels and excavators ..	No.	-	-	-	-	18 [illegible].0	
51. Road rollers ..	No.	-	100.0	50.0	-	6 500.0	
52. Dairy machinery ..	Million Rials	-	350.0	70.0	-	180.[illegible]	1
D. Metal products							
53. Steel furniture ..	ton	-		43.0	-	11.0	1
54. Steel wire ropes a/ ..	ton	-	-	-	-	-	
55. Expanded metal ..	ton	-	.	.	.		
56. Bolts, nuts and rivets ..	ton	.	-	-	.	-	
57. Builders hardware a/ ..	ton	-	-	-	.	.	
58. Tanks ..	ton	.	-	150.0	.	900.0	
59. Gas cylinders ..	No.	.	-	-	-		
60. Wire nails, wood, machine screws ..	ton	-	-	-	-	-	
61. Wire netting and wire products ..	ton	-	-	-	.		
62. Stoves ..	No.		.	.			
63. Sewing machines ..	No.	.	-	-	.	0.1	
64. Typewriters and office machines ..	No.			-	.	-	
65. Steel drums and containers ..	ton	-	-			-	1
66. Tin cans ..	ton	-			-	.	
67. Arc welding (electrodes) ..	ton	-	.	.	-		
68. Steel doors and windows ..	ton			1[illegible].0		1[illegible]	
69. Heavy pipes and tubes ..	ton	-					

SECTION 1

...s	Structurals Channels	Angles	Tees	Plates	Plain sheets/strips Cold rolled	Hot rolled	Coated sheets Galvanised	Tinned	Wires	Bars/ rods	Pipes/ tubes	Tot
	-	-	-	3 000.0	500.0	250.0	-	-	-	250.0	100.0	4 10
	2 491.0	1 835.0	-	3 018.0	3 607.5	-	-	-	3.5	980.0	65.0	12 00
	-	1.0	-	-	-	50.0	-	-	1.0	65.0	3.0	12
.0	257.0	290.0	4.0	78.0	-	15.5	-	-	2.0	114.0	10.0	81
.0	114.0	242.0	-	158.0	128.0	66.0	197.0	-	1.0	-	-	1 00
.0	330.0	700.0	-	400.0	370.0	190.0	570.0	-	2.0	-	-	2 89
	7.0	27.0	-	400.0	-	25.0	-	-	-	45.0	-	50
.0	783.0	1 407.0	-	2 882.0	1 566.0	-	-	-	-	470.0	1 877.0	9 00
	-	100.0	-	4 000.0	-	-	-	-	-	100.0	3 300.0	7 5
	-	18.15	-	244.25	-	6.60	-	-	-	195.50	195.50	66
-		22.00	-	296.00	-	8.00	-	-	-	237.00	237.00	8
	-	27.50		370.00	-	10.00	-	-	-	296.25	296.25	1 0
	-	-	-	-	-	-	-	-	-	15.0	6.0	
.0	217.0	313.0	-	3 195.0	75.0	93.0	-	-	625.0	1 250.0	610.0	6 7
.0	800.0	400.0	-	4 000.0	150.0	-	5.0	:	-	600.0	900.0	7 0
.0	300.0	450.0	-	6 000.0	570.0	-	15.0	-	-	1 000.0	600.0	9 7
.0	28.0	20.0	4.0	380.0	150.0	18.8	0.2	-	-	135.0	38.0	8
.0	7.0	17.0	1.0	874.0	10.0	10.0	-	-	-	-	150.0	1 0
.0	15.0	200.0	-	440.0	45.0	60.0	-	-	30.0	290.0	300.0	1 3
	-	-	-	-	-	-	-	-	-	4 000.0	-	4 0
	-	-	-	-	-	-	-	-	-	870.0	-	87
.0	200.0	150.0	-	5 500.0	2 500.0	-	-	-	-	200.0	-	8 6
	-	-	-	18 000.0	-	1 500.00	-	-	-	1 500.0	1 000.0	22 00
	100.0	50.0	-	6 500.0	-	90.0	-	-	-	180.0	60.0	7 2
	350.0	70.0	-	180.0	1 200.0	-	-	-	-	110.0	50.0	1 9
		48.0	-	11.0	1 000.0	-	-	-	-	20.0	39.0	1 1
	-	-	-	-	-	-	-	-	11100.0	-	-	1 1
	-	-	-	-	-	1 100.00	-	-	-	-	-	1 1
	-	-	-	-	-	-	-	-	450.0	1 050.0	-	1 5
	-	-	-	-	480.0	-	-	-	-	170.0	-	6
	-	180.0	-	900.0	-	100.0	-	-	-	-	-	1 1
	-	-	-		18.0	-	-	-	-	1.0	1.0	
	-	-	-	-	-	-	-	-	-	1 080.0	-	1 0
	-	-	-	-	-	-	-	-	1 100.0	-	-	1 1
	-	-	-		18.0	-	-	-	-	3.0	-	
	-	-	-	0.1	1.0	1.0	-	-	-	3.5	-	
	-	-	-	-	14.5	-	-	-	-	3.5	-	
-	-	-		-	1 976.0	-	-	-	-	-	-	1
	-	-	-	-	-	-	-	1 100.0	-	-	-	1 1
	-	-	-	-	-	-	-	-	-	700.0	-	7
	-	15.0		10.0	1 000.0	-	-	-	-	20.0	60.0	1
			-	-	-	1 900.0	-		-	-	-	1

SECTION 2

Plain sheets/strips Cold rolled	Hot rolled	Coated sheets Galvanized	Tinned	Wires	Bars/rods	Pipes/tubes	Total
800.0	250.0	-	-	-	250.0	100.0	4 100.0
5 607.5	-	-	-	3.5	980.0	65.0	12 000.0
-	50.0	-	-	1.0	65.0	5.0	120.0
-	15.5	-	-	2.0	114.0	10.0	810.0
128.0	66.0	197.0	-	1.0	-	-	1 000.0
370.0	190.0	570.0	-	2.0	-	-	2 602.0
-	25.0	-	-	-	45.0	-	504.0
1 566.0	-	-	-	-	470.0	1 877.0	9 000.0
-	-	-	-	-	100.0	3 300.0	7 500.0
-	6.60	-	-	-	196.50	196.50	660.0
-	8.00	-	-	-	237.00	237.00	800.0
-	10.00	-	-	-	296.25	296.25	1 000.0
-	-	-	-	-	15.0	6.0	21.0
75.0	95.0	-	-	625.0	1 250.0	610.0	6 708.0
150.0	-	5.0	-	-	600.0	900.0	7 655.0
570.0	-	15.0	-	-	1 000.0	600.0	9 765.0
150.0	18.8	0.2	-	-	135.0	38.0	800.0
10.0	10.0	-	-	-	-	150.0	1 076.0
45.0	60.0	-	-	30.0	290.0	300.0	1 395.0
-	-	-	-	-	4 000.0	-	4 000.0
-	-	-	-	-	870.0	-	870.0
2 500.0	-	-	-	-	200.0	-	8 600.0
-	1 500.00	-	-	-	1 500.0	1 000.0	22 000.0
-	80.0	-	-	-	480.0	60.0	7 270.0
1 200.0	-	-	-	-	110.0	50.0	1 960.0
1 000.0	-	-	-	-	80.0	38.0	1 118.0
-	-	-	-	11100.0	-	-	1 100.0
-	1 100.00	-	-	-	-	-	1 100.0
-	-	-	-	450.0	1 050.0	-	1 500.0
450.0	-	-	-	-	170.0	-	600.0
-	100.0	-	-	-	-	-	1 150.0
18.0	-	-	-	-	1.0	1.0	20.0
-	-	-	-	-	1 080.0	-	1 080.0
-	-	-	-	1 100.0	-	-	1 100.0
15.0	-	-	-	-	3.0	-	18.0
1.0	1.0	-	-	-	3.5	-	5.6
14.5	-	-	-	-	3.5	-	18.0
1 276.0	-	-	-	-	-	-	1 276.0
-	-	-	1 100.0	-	-	-	1 100.0
-	-	-	-	-	700.0	-	700.0
1 000.0	-	-	-	-	20.0	[illegible]	1 118.0
-	1 200.0	-		-	-	-	1 200.0

SECTION 3

Item	Unit	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
II. [illegible]						
A. Large and medium industries and mining	Million Rials of total outlay	[illegible]	[illegible]	1 [illegible]	-	[illegible]
B. Agricultural and allied activities	"	400	[illegible]	[illegible]	[illegible]	[illegible]
C. Oil and gas	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D. Irrigation	"	[illegible]	180	[illegible]	18	1 [illegible]
E. Roads and bridges	"	[illegible]	[illegible]	[illegible]		
F. Social services 72	"	18 [illegible]	1 [illegible]	[illegible]	[illegible]	
77	"	[illegible]	1 [illegible]	[illegible]	[illegible]	
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]	.
G. Tele-communications (Posts, telegraph, telephones and radio)	"	[illegible]	[illegible]	[illegible]		
H. Airports	"	[illegible]	[illegible]	1[illegible]		
I. Ports and harbours	"	1 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
J. Power supply generation						
a) Hydel	100 MW	1 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
b) Thermal	100 MW	[illegible]	[illegible]	[illegible]	1 [illegible]	[illegible]
a) Transmission 400 KV	km	-	-	14 [illegible]	-	[illegible]
b) Transmission 230 KV	km	-	-	[illegible]	-	[illegible]
c) Transmission 132 KV	km	-	-	10 [illegible]		[illegible]
Distribution	Million Rials of total outlay	-	.	1 [illegible]	.	[illegible]
K. Rail transport						
New Rail lines — Rails [illegible] 000; Fish plates 4 000	km	.	-	-	-	[illegible] (sleepers)
[illegible] and [illegible] — [illegible]						
Track renewal — Rails [illegible]; 2 000	km	-	-	-	-	[illegible] (sleepers)
Electrification	km	17 [illegible]	[illegible] 000	[illegible]	[illegible]	[illegible]
Maintenance (wagon supply)	No.	-	[illegible]	[illegible]	.	[illegible]
Signalling and safety works	km	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1/ Norms for jeeps and station wagons is lower than in other countries due to extensive use of ...
2/ Norms for airconditioners take into account both domestic and commercial units. The allowance ...
3/ Steel wire rope is made of high carbon steel.
4/ Builders hardware will be mostly brass and aluminium. For certain parts such as ... hinges ...

SECTION 1

(stamped)

(stamped)

SECTION 2

SECTION 3

Appendix 6-1 (continued)

Table 6-1-1

PRODUCTS TO BE PACKED IN TIN CANS

Products	Quantity ('000 tons) 1972	1977	1982	Norms h/ kg of tinplate/ton of product
Vegetable and hydrogenated oil a/ ..	125.00	110.00	140.00	116.00
Biscuits and confectionery b/ ..	51.00	79.00	120.00	108.00
Tea c/	11.00	13.00	15.00	55.50
Barley d/	31.00	37.00	38.50	64.00
Processed food	22.50	39.50	60.00	95.00
Paints and varnishes	12.00	16.20	17.40	90.00
Oil and lubricants	130.00	180.00	250.00	100.00
Shoe polish e/	0.90	1.12	1.50	500.00
Tobacco f/ ..	0.60	0.76	0.84	400.00
Meat, preserved fish g/ and caviare ..	0.48	0.56	0.63	100.00

a/ Of the total amount, an estimated 60% requires to be packed in tin cans

b/ As paper and plastics are also used for packing, only 65% of the total amount is considered to require packing in tin cans.

c/ 50% is considered to be packed in tin cans and the rest in foil and paper packing.

d/ Only 15% is taken to be packed in tin cans, as other cheaper packing materials are extensively used, especially for bulk packing.

e/ Amount in tons has been calculated on the basis of 100 gms of shoe polish packed in tinplate containers weighing 50 gms.

f/ Tin cans are required for packing prepared tobacco leaves only which will be about 20% of the total.

g/ Of the total amount, only 5% is taken to be canned, the rest being sold directly.

h/ Various sizes of cans are used and requirement of tinplate for manufacturing these cans also vary widely. The norms given are weighted average figures.

[illegible]

Appendix [illegible]

[illegible] OF [illegible] STEEL

[illegible]

Appendix [illegible]

... Type constructional steel	Free cutting steel	[illegible] steel	Alloy constructional steel	Stainless steel	Electrical sheets	Total
1.3	-	1 [illegible].0	-	-	-	1 [illegible]1.8
.8	-	[illegible].0	20.4	-	-	[illegible].0
[illegible]	10.0	710.0	105.0	-	-	[illegible].0
[illegible]	[illegible]	45.0	87.0	-	-	[illegible].0
[illegible]	10.0	220.0	[illegible].0	-	-	[illegible].0
[illegible].0	10.0	60.0	10[illegible].0	-	-	[illegible].0
[illegible]	1.0	1.0	7.0	-	-	11.0
[illegible].0	100.0	100.0	[illegible].0	1.8	-	101.8
[illegible]	[illegible].0	-	[illegible].0	1.0	-	[illegible].0
[illegible].0	-	-	-	-	-	[illegible].0
[illegible]	1.0	1.0	7.0	-	-	12.0
-	-	1 100.0	-	-	-	1 100.0
-	-	-	-	-	9 [illegible].0	9 [illegible].0
[illegible]	-	-	-	-	8 [illegible].0	8 [illegible].0
[illegible]	-	-	-	-	8 400.0	8 [illegible].0
[illegible].0	[illegible].0	-	-	-	7 [illegible].0	7 [illegible].0
[illegible].0	[illegible].0	-	-	-	7 [illegible].0	7 [illegible].0
[illegible].0	1[illegible].0	-	-	-	8 [illegible].0	8 [illegible].0
[illegible].0	[illegible]	10.0	10.0	-	[illegible].0	[illegible].0
	-	-	-	-	0.[illegible]	[illegible]
[illegible]	-	-	[illegible].0	-	-	[illegible]
[illegible]	[illegible].0	[illegible].0	[illegible]	[illegible].0	-	8 [illegible].0
	-	[illegible].0	-	8 [illegible].0	-	8 [illegible].0
1.0	-	[illegible].0	-	[illegible].0	-	[illegible].0
	-	[illegible].4	-	[illegible].0	-	[illegible].4
	[illegible].0	[illegible].0	-	-	-	[illegible].0
	-	-	[illegible].0	[illegible].0	-	[illegible].0
[illegible].0	[illegible].0	-	[illegible].0	-	-	[illegible].0
	[illegible].0	[illegible].0	[illegible].0	-	-	[illegible].0
[illegible].0	[illegible].0	[illegible].0	[illegible].0	-	-	[illegible].0
	[illegible].0	[illegible].0	8 [illegible].0	[illegible].0	-	8 [illegible].0
[illegible].0	1[illegible].0	[illegible].0	[illegible].0	[illegible].0	-	[illegible].0
[illegible].0	-	1.0	7.0	1.0	-	[illegible].0
[illegible].0	[illegible].0	[illegible].0	[illegible].0	-	-	[illegible].0
	-	[illegible].0	[illegible].0	-	-	[illegible].0
	-	[illegible].0	[illegible].0	-	-	[illegible].0
[illegible]	10.0	[illegible].0	[illegible].0	-	-	[illegible].0

SECTION 9

Appendix [illegible]

[illegible] steel	Alloy constructional steel	Stainless steel	Electrical sheets	Total
.0	-	-	-	1 [illegible]
.0	[illegible]	-	-	[illegible]
.0	[illegible]	-	-	[illegible]
[illegible]	[illegible]	-	-	[illegible]
.0	[illegible]	-	-	[illegible]
.0	[illegible]	-	-	[illegible]
.0	7.0	-	-	11.0
.0	[illegible]	1.0	-	[illegible]
	[illegible]	1.0	-	[illegible]
	-	-	-	[illegible]
[illegible]	[illegible]	-	-	[illegible]
.0	-	-	-	1 [illegible]
	-	-	[illegible]	[illegible]
	-	-	[illegible]	[illegible]
	-	-	[illegible]	[illegible]
	-	-	[illegible]	[illegible]
	-	-	[illegible]	[illegible]
	-	-	[illegible]	[illegible]
[illegible]	[illegible]	-	[illegible]	[illegible]
	-	-	[illegible]	[illegible]
	[illegible]	-	-	[illegible]
.0	[illegible]	[illegible]	-	[illegible]
.0	-	[illegible]	-	[illegible]
.0	-	[illegible]	-	[illegible]
[illegible]	-	[illegible]	-	[illegible]
.0	-	-	-	[illegible]
	[illegible]	[illegible]	-	[illegible]
	[illegible]	-	-	[illegible]
[illegible]	[illegible]	-	-	[illegible]
.0	[illegible]	-	-	[illegible]
.0	[illegible]	[illegible]	-	[illegible]
[illegible]	[illegible]	[illegible]	-	[illegible]
.0	[illegible]	[illegible]	-	[illegible]
.0	[illegible]	-	-	[illegible]
.0	[illegible]	-	-	[illegible]
.0	[illegible]	-	-	[illegible]
[illegible]	[illegible]	-	-	[illegible]

SECTION 3

Item	Unit	[illegible]		[illegible]
[illegible] Industrial and [illegible] machinery (Cont'd)				
37 Other material handling equipment (conveying machinery)	[illegible]		[illegible]	-
38 Industrial boilers	[illegible]		-	-
39 Air compressors	Mill. [illegible]	[illegible]	7.0	[illegible]
		[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]
40 Power driven pumps (centrifugal and turbine)	[illegible]		-	[illegible]
41 Textile machinery	[illegible]		[illegible]	[illegible]
42 Paper machinery	[illegible]		-	[illegible]
43 Cement machinery	[illegible]		[illegible]	-
44 Equipment for chemical industry ..	[illegible]		-	-
45 Heavy plate vessel works	[illegible]		-	-
46 Machine tools	Mill. [illegible]		[illegible]	[illegible]
47 Machine tool accessories	Mill. [illegible]		[illegible]	[illegible]
48 Hand tools	[illegible]		-	-
49 [illegible] and [illegible]				
50 [illegible] and [illegible]	[illegible]		[illegible]	[illegible]
51 [illegible]	[illegible]		-	[illegible]
52 [illegible] machinery	Mill. [illegible]		-	
[illegible] Metal products				
53 [illegible] ..	[illegible]		[illegible]	-
54 Bolts, nuts and rivets ..	[illegible]		[illegible]	[illegible]
55 [illegible]	[illegible]		[illegible]	-
56 [illegible] and [illegible] products	[illegible]		-	-
57 [illegible]	[illegible]		-	[illegible]
58 [illegible] and office [illegible] ..	[illegible]		[illegible]	-
59 [illegible]	Mill. [illegible]		-	-
60 [illegible] ..	[illegible]		-	-
61 [illegible] ..	[illegible]		[illegible]	-
62 [illegible] ..	[illegible]		[illegible]	-
63 [illegible]	Mill. [illegible]		-	
64 [illegible] ..	[illegible]		-	-

[illegible]

SECTION 1

Appendix [illegible] (continued)

Carbon constructional steel	Free cutting steel	[illegible]	Alloy constructional steel	Stainless steel	Electrical sheets	Total
[illegible]	-	-	[illegible]	[illegible]	-	[illegible]
-	-	[illegible]	1 [illegible]	[illegible]	-	1 [illegible]
7.0	[illegible]	7.0	[illegible]	[illegible]	-	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1.0	-	[illegible]
10.0	[illegible]	[illegible]	[illegible]	1.4	-	[illegible]
-	[illegible]	-	[illegible]	[illegible]	-	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
-	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]
-	-	-	[illegible]	[illegible]	-	[illegible]
-	-	-	-	[illegible]	-	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
[illegible]	[illegible]	[illegible]	1 [illegible]	[illegible]	-	1 [illegible]
-	-	-	[illegible]	-	-	[illegible]
[illegible]	[illegible]	[illegible]	1 [illegible]	-	-	1 [illegible]
-	[illegible]	[illegible]	[illegible]	-	-	[illegible]
-	-	-	-	[illegible]	-	[illegible]
[illegible]	-	-	-	-	-	[illegible]
[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]
[illegible]	-	-	-	-	-	[illegible]
-	-	-	-	[illegible]	-	[illegible]
-	[illegible]	[illegible]	-	-	-	[illegible]
[illegible]	-	[illegible]	1 [illegible]	-	-	1 [illegible]
-	-	-	-	[illegible]	-	[illegible]
-	-	-	-	[illegible]	-	[illegible]
[illegible]	-	-	-	-	-	1 [illegible]
[illegible]	-	-	-	-	-	[illegible]
-	-	-	[illegible] [illegible]	-	-	[illegible] [illegible]
-	-	-	-	-	-	-

[illegible]

[illegible]

SECTION 9

Appendix [illegible] (continued)

[illegible] steel	Alloy constructional steel	Stainless steel	Electrical sheets	Total
-	[illegible].0	[illegible].0	-	[illegible]0.0
4.0	1 [illegible].0	[illegible].0	-	1 0[illegible].0
7.0	[illegible].0	1.0	-	1[illegible].0
[illegible]	[illegible]	1.2	-	170.0
[illegible]0.0	[illegible]	1.4	-	[illegible]0.0
-	0.[illegible]	2.0	-	[illegible].0
[illegible].0	[illegible]	[illegible].0	-	[illegible].0
[illegible].0	1[illegible].0	[illegible].0	-	[illegible].0
[illegible].0	[illegible].0	[illegible].0	-	[illegible].0
-	[illegible].0	1[illegible].0	-	[illegible].0
-	-	[illegible].0	-	[illegible].0
[illegible].0	1[illegible].0	2.0	-	[illegible]0.0
0.0	1 [illegible].0	[illegible].0	-	1 [illegible].0
-	[illegible].0	-	-	[illegible].0
[illegible].0	[illegible] [illegible].0	-	-	[illegible] [illegible].0
[illegible].0	[illegible].0	-	-	[illegible].0
-	-	[illegible].0	-	[illegible].0
-	-	-	-	[illegible].0
-	[illegible].0	1[illegible] 0	-	1[illegible].0
-	-	-	-	0.7
-	-	[illegible].0	-	[illegible].0
[illegible].0	-	-	-	[illegible].0
0.0	1 [illegible].0	-	-	1 [illegible].0
-	-	[illegible].0	-	[illegible].0
-	-	[illegible].0	-	[illegible].0
-	-	-	-	1 [illegible].0
-	-	-	-	1[illegible]
	[illegible] [illegible].0	-	-	[illegible] [illegible].0
-	-	-	-	-

[illegible]

SECTION 3

SECTION 1

Appendix [illegible]

OUTPUT FORECAST

Item	Unit of output	1972	1977	1982
[illegible]				
a. [illegible]				
a. [illegible] engines ..	No.	100	800	1 000
b. Tr[illegible] ..	"	300	4 000	8 000
c. [illegible] ..	"	9 000	26 000	45 000
d. [illegible] ..	"	50 000	90 000	162 000
e. [illegible] ..	"	4 [illegible]	12 500	22 000
f. Pumps, [illegible] engines, [illegible] and supports ..	"	14 000	28 000	50 000
g. Motor cycles, scooters and mopeds	"	30 000	56 000	88 000
h. Automobile [illegible] ..	Million Rials	[illegible]	1 265	1 817
i. [illegible] ..	No.	10 [illegible]	13 500	24 000
j. [illegible] ..	"	[illegible]	89 000	142 000
k. [illegible] ..	"	100 000	180 000	300 000
l. [illegible] springs ([illegible])	Ton	4 [illegible]	5 400	7 000
b. [illegible]				
a. [illegible] ..	1000 KVA	1 [illegible]	1 400	2 500
b. [illegible] ..	1000 KW	[illegible]	150	250
c. [illegible] ..	Million Rials		[illegible]	1 950
d. Transmission towers, [illegible]	Ton	12 [illegible]	12 000	18 000
e. [illegible] ..	No.	[illegible]	80 000	125 000
f. [illegible] ..	"	[illegible]	250 000	375 000
g. [illegible] ..	"	[illegible]	170 000	270 000
h. [illegible] ..	"	5 [illegible]	75 000	120 000
i. [illegible] ([illegible])	"	[illegible]	400 000	1 [illegible] 000
j. [illegible] ..	"	10 [illegible]	20 000	35 000
k. [illegible] ..	"	[illegible]	270 000	675 000
l. [illegible] ..	1000 No.	[illegible]	504	780
m. [illegible] ..	"	[illegible]	115	[illegible]
n. [illegible] ..	Million Rials	-	7.2	60
o. [illegible] ..	"	-	1.72	1.5
p. [illegible] ..	Ton	-	3 070	2 150
[illegible]				

[illegible]

SECTION 2 [illegible]

SECTION 3

SECTION I

Appendix 6-1 (continued)

Table 6-1-2

BREAK-DOWN OF TINPLATE REQUIREMENTS FOR DIFFERENT PACKAGED PRODUCTS

(Tons)

	Coating weight lb/base box a/	Type ET b/	Type HD c/	Requirements 1972 ET	1972 HD	1977 ET	1977 HD	1982 ET	1982 HD
Vegetable and hydro-generated product d/ ..	0.75/1.50	-do-	-do-	11 760	2 940	10 272	2 568 e/	13 064	3 266 e/
Biscuits and confectionery ..	0.25	-do-	-	5 500	-	8 500	-	13 000	-
Tea	0.25/0.50	-do-	-	720	-	850	-	980	-
Barley	0.25/0.50	-do-	-	2 600	-	3 100	-	3 225	-
Processed food:									
a) acid food f/ ..	1.00/1.50	-	-do-	-	636	-	1 125	-	1 686
b) Other food ..	0.50	-do-	-do-	1 489	-	2 625	-	5 934	-
Paint and varnishes ..	0.25	-do-	-	1 080	-	1 450	-	1 550	-
Shoe polishes ..	0.25	-do-	-do-	450	-	560	-	650	-
Oil and lubricating ..	0.25 to 0.50	-do-	-	13 000	-	18 000	-	25 000	-
Tobacco	0.25 to 0.50	-do-	-	240	-	304	-	336	-
Meat, preserved fish and caviare ..	1.00 to 1.50	-	-do-	-	48	-	56	-	63
Total				36 839	3 624	45 661	3 759	57 439	5 015
Others 20%				7 380	725	9 132	752	11 488	1 000
Grand Total				44 219	4 349	54 793	4 511	68 927	6 015
Say				44 300	4 400	54 800	4 500	69 000	6 000

a/ Base box is equivalent to 20.232 sq m of surface.
b/ ET - electrolytic tinplate
c/ HD - hot dip tinplate
d/ For determining hot dip tinplate requirement, 20% has been taken for canning acid food
e/ Certain grades of vegetable oils are packed in plastic containers; for estimating future requirement of tinplate, 25% substitution of tinplates by 1977 and 50% substitution by 1982 have been considered.
f/ 30% out of total requirement has been assumed for packing of acid food.

[illegible]	[illegible]	16 300	27 000	45 400
[illegible]	[illegible]	6 200	6 000	8 000
[illegible]	[illegible]	5 300	9 250	15 300
[illegible]	[illegible]	9 000	13 500	19 400
[illegible]	[illegible]	3 100	5 300	8 900
[illegible]	[illegible]	16 910	28 200	33 100
[illegible]	[illegible]	875	1 330	1 900
[illegible]	[illegible]	1 000	1 500	2 140
[illegible]	[illegible]	1 200	1 600	3 440
[illegible]				
[illegible] (a) [illegible]	[illegible]	300	350	465
(b) [illegible]	[illegible]	50	60	90
[illegible] (a) [illegible]	[illegible]	-	200	300
(b) [illegible]	[illegible]	600	450	530
(c) [illegible]	[illegible]	200	280	310
[illegible]	[illegible]	765	1 110	1 410
[illegible]				
[illegible]	[illegible]	300	310	600
[illegible]	[illegible]	136	136	136
[illegible]	[illegible]	-	150	300
[illegible]	[illegible]	2 300	3 000	4 400
[illegible]	[illegible]	300	900	400

SECTION 9

Appendix [illegible] (continued)

[illegible]		•	875	1 330	1 900
[illegible]		•	1 [illegible]	1 [illegible]	2 140
[illegible]		•	1 [illegible]	1 [illegible]	3 440
[illegible]					
[illegible]	(a) [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	(b) [illegible]	[illegible]	30	[illegible]	40
[illegible]	(a) [illegible]	[illegible]	-	[illegible]	300
	(b) [illegible]	[illegible]	[illegible]	450	520
	(c) [illegible]	[illegible]	[illegible]	[illegible]	310
[illegible]		[illegible]	[illegible]	1 220	1 480
[illegible]					
[illegible]		[illegible]	300	320	600
[illegible]		[illegible]	136	136	136
[illegible]		[illegible]	-	150	300
[illegible]		[illegible]	2 [illegible]	3 [illegible]	4 400
[illegible]		[illegible]	300	500	400

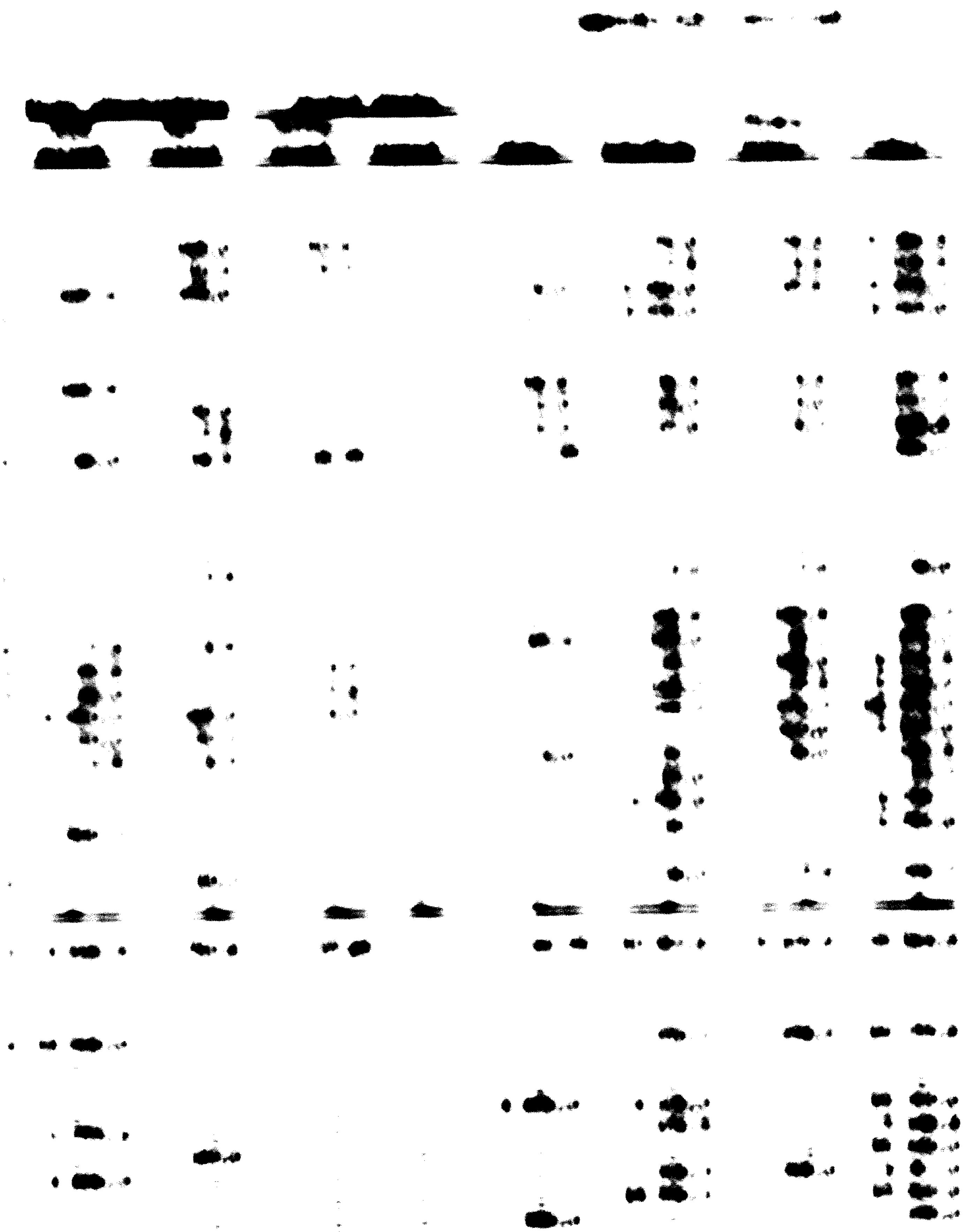
SECTION [illegible]

SECTION 1

SECTION [illegible]

SECTION 1

SECTION 9



SECTION 3

SECTION 1

SECTION 2

Appendix 6-2

BASIC ECONOMIC INDICATORS OF I.

Indicators	Unit	1959	1960	1961	196
Net national income a/ at market prices	billion Rials	266.9	289.8	295.0	301
Per capita income b/	thousand Rials	12.3	13.0	12.9	1
Population	millions	21.7	22.2	22.8	2
Gross domestic product c/ at market prices	billion Rials	299.1	318.1	334.9	35
Gross fixed capital formation ..	billion Rials	48.1	56.5	55.3	4.
Constructional activity at constant 1959 prices	billion Rials	15.0	17.9	19.1	1
Index of industrial production (1963 = 100) ..	numbers	70.0	75.0	81.0	[illegible]
Gross national product d/ at market prices	billion Rials	307.4	333.3	341.3	35

a/ National income has been calculated by subtracting indirect taxation and amortisation of fixed

b/ Per capita income is national income divided by population.

c/ Gross domestic product is contributed by fixed domestic investment plus exports of goods and s
goods and services.

d/ Total consumption both private and public plus domestic savin s gives gross national product

Source: Industrial development of Iran, Research Centre
Brief note on population of Iran - by Engr. Shaheen
Bulletin of monthly statistics, U.N.
Monthly Bulletin of Bank Markazi
Fourth Development Plan of Iran, Plan Organisation, Teheran.

SECTION 1

SECTION 3

SECTION 1

SECTION 2

SECTION 1

SECTION 2

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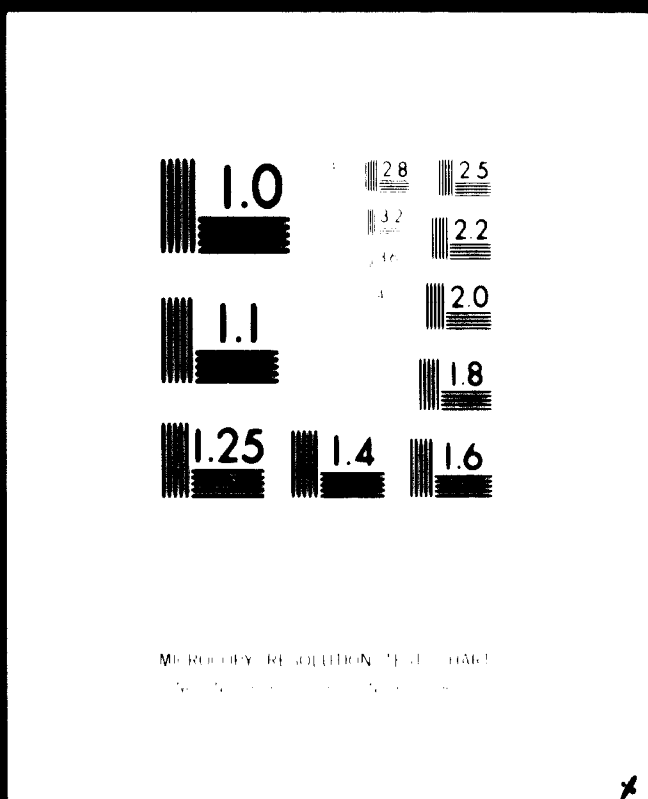

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Appendix 6-ii (continued)

Plates	Plain sheets/strips C.rolled	Plain sheets/strips H.rolled	Coated sheets Galvanised	Coated sheets Tinned	Wires	Bars/rods	Pipes/tubes/	Total
900.0	-	900.0	-	-	2 700.0	900.0	480.0	6 210.0
-	-	-	-	-	-	-	-	-
120.0	-	9.0	-	-	45.0	750.0	150.0	5 802.0
150.0	-	1 050.0	-	-	-	150.0	75.0	1 545.0
1 170.0	-	1 959.0	-	-	2 745.0	1 800.0	675.0	13 557.0
241 653.0	374.801.31	313 896.0	95 171.06	66 000.0	17 387.8	348 155.8	84 241.2	1 977 919.3

Fish bolts	Sleepers	Dog spikes	Points and crossings		Total
			B/F	..	1 977 919.3
300.0	21 600.0	450.0	1 050.0		50 100.0
68.0	9 810.0	-	-		20 850.0
-	-	-	-		-
-	-	-	-		-
368.0	31 410.0	450.0	1 050.0		70 950.0
	..		..		150 000.0
	..		..		2 198 849.3

Append

STEEL REQUIREMENT
(To

Item	Unit of output	Antici-pated output	Structurals				Plate
			Beams	Channels	Angles	Tees	
I. MANUFACTURED ITEMS							
A. Transport equipment							
1. Railway wagons	No	1 000.0	552.0	2 979.0	236.0	25.0	5 633.
2. Trailers	No	8 000.0	-	2 080.0	8 000.0	-	744.
3. Buses and mini buses	No	45 000.0	-	-	2 700.0	-	22 500.
4. Cars	No	162 000.0	-	-	-	-	1 620.
5. Trucks	No	22 000.0	-	660.0	1 100.0	220.0	11 000.
6. Jeeps, station wagons, ambulances and vannets	No	50 000.0	-	-	-	-	750.
7. Motor cycles, scooters and mopeds	No	88 000.0	-	-	-	-	506.
8. Automobile ancillaries	Mill Rials	1 917.0	-	-	-	-	7 100.
9. Vehicular diesel engines	No	24 000.0	-	-	144.0	-	4 320.
9a. Vehicular petrol engines	No	162 000.0	-	-	-	-	-
10. Bicycles complete	No	300 000.0	-	-	-	-	-
	Sub-total A		552.0	5 719.0	12 180.0	245.0	54 173.
B. Electrical equipment							
11. Electric transformers	1 000 MW	2 560.0	36.0	640.0	328.0	-	1 221.
12. Electric motors	1 000 MW	250.0	-	-	-	-	-
13. Switch and control gear	Mill Rials	1 650.0	-	200.0	500.0	-	415.
14. Transmission towers including micro wave towers etc	ton	20 000.0	-	1 200.0	22 000.0	-	600.
15. House service meters	1 000 Nos	125 000.0	-	-	-	-	-
16. Electric fans	No	375 000.0	-	-	-	-	-
17. Air coolers	No	270 000.0	-	-	-	-	-

SECTION 1

Appendix 6-12

STEEL REQUIREMENT FOR THE YEAR 1962
(Tonnage)

...ructurals				Plain sheet/strips coated sheets						
...nels	Angles	Tees	Plates	Cold rolled	Hot rolled	Galvanised	Tinned	Wires	Bars/ rods	...
79.0	236.0	25.0	5 653.0	-	250.0	-	-	-	1 075.0	
30.0	8 000.0	-	744.0	-	4 216.0	-	-	-	-	
-	2 700.0	-	22 500.0	67 800.0	4 500.0	3 600.0	-	-	11 250.0	4
-	-	-	1 680.0	97 416.0	9 742.0	-	-	1 137.0	18 184.0	
60.0	1 100.0	220.0	11 000.0	22 000.0	1 100.0	1 100.0	-	-	3 300.0	
-	-	-	750.0	20 000.0	3 000.0	-	-	100.0	1 250.0	1
-	-	-	506.0	2 270.0	304.0	-	-	25.0	455.0	
-	-	-	7 100.0	765.0	1 000.0	970.0	-	-	310.0	
-	144.0	-	4 320.0	48.0	720.0	-	-	-	528.0	
-	-	-	-	380.0	-	-	-	-	-	
-	-	-	-	2 520.0	270.0	-	-	600.0	2 250.0	1
9.0	12 180.0	245.0	54 173.0	212 869.0	25 102.0	5 670.0		1 862.0	38 602.0	9
0.0	328.0	-	1 221.0	-	897.0	-	-	-	640.0	1
	-	-	-	-	160.0	-	-	-	171.0	
0.0	500.0	-	415.0	2 900.0	-	-	-	-	750.0	
0.0	22 000.0	-	600.0	-	-	-	-	-	1 600.0	
	-	-	-	125.0	-	-	-	-	7.5	
	-	-	-	55.0	960.0	-	-	135.0	557.0	
	-	-	-	6 480.0	-	-	-	-	-	

SECTION 2

YEAR 1982

Plain sheet/strips Cold (r)olled	Plain sheet/strips Hot rolled	Coated sheets Galvanised	Coated sheets Tinned	Wires	Bars/ rods	Pipes/ tubes	Total
-	250.0	-	-	-	1 075.0	50.0	10 800.0
-	4 216.0	-	-	-	-	-	15 040.0
500.0	4 500.0	3 600.0	-	-	11 250.0	4 500.0	116 550.0
416.0	9 742.0	-	-	1 137.0	18 184.0	812.0	128 911.0
000.0	1 100.0	1 100.0	-	-	3 300.0	660.0	41 140.0
000.0	3 000.0	-	-	100.0	1 250.0	1 750.0	26 850.0
270.0	304.0	-	-	25.0	455.0	380.0	3 940.0
765.0	1 000.0	970.0	-	-	310.0	190.0	10 355.0
48.0	720.0	-	-	-	528.0	72.0	5 852.0
350.0	-	-	-	-	-	-	350.0
520.0	270.0	-	-	600.0	2 250.0	1 280.0	6 900.0
869.0	25 102.0	5 670.0		1 862.0	38 602.0	9 674.0	366 648.0
-	897.0	-	-	-	640.0	1 280.0	4 447.0
-	160.0	-	-	-	171.0	-	331.0
900.0	-	-	-	-	750.0	580.0	5 545.0
-	-	-	-	-	1 600.0	-	25 400.0
25.0	-	-	-	-	7.5	-	132.5
53.0	960.0	-	-	133.0	557.0	133.0	1 836.0
480.0	-	-	-	-	-	-	6 480.0

Item	Unit of output	Antici-pated output	Structurals: Beams	Channels	Angles	Tees	Plates	r
B. Electrical equipment (cont'd)								
18. Air conditioners	No	120 000.0	-	1 332.0	2 220.0	880.0	-	1
19. Refrigerators (domestic and commercial)	No	1 062 000.0	-	-	-	-	-	6
20. Water coolers	No	35 000.0	-	-	131.0	-	-	
21. Water heaters	No	475 000.0	-	-	-	-	-	
22. Radio receivers	No	790 000.0	-	-	-	-	-	
23. Television sets	No	200 000.0	-	-	-	-	-	
24. P.A. System	Mill Rials	60.0	-	11.0	41.0	-	-	
25. Electric and electronic equipment	Mill Rials	1.5	-	-	-	-	-	
26. Electrical conductors (ACSR)	ton	2 330.0	-	-	-	-	-	
Sub-total B			36.0	3 383.0	25 225.0	888.0	2 236.0	9
C. Industrial and agricultural								
27. Tea processing machinery	Mill Rials	140.0	-	196.0	686.0	-	1 470.0	
28. Weighing machinery	Mill Rials	231.0	35.0	80.0	80.0	-	460.0	
29. Agricultural tractors	No	10 000.0	-	300.0	100.0	-	400.0	
30. Agricultural implements	ton	12 000.0	-	-	-	-	216.0	
31. Crawler tractors	No	30.0	-	-	-	-	150.0	
32. Building and road construction machinery	Mill Rials	250.0	-	625.0	457.5	-	755.0	
33. Stationary diesel engines	No	25 000.0	-	-	25.0	-	-	
34. Cranes	ton	3 000.0	120.0	771.0	870.0	12.0	234.0	
35. Passenger and industrial lifts	No	700.0	92.5	92.5	196.0	-	112.0	
36. Fork lifts	No	100.0	-	0.7	2.7	-	40.0	

SECTION 1

Tees	Plates	Plain sheet/strips coated sheets: Cold rolled	Hot rolled	Galvanised	Tinned	Wires	Bars/ rods	Pipes/ tubes	Tota
88[illegible].0	-	14 386.0	-	2 664.0	-	-	2 220.0	266.0	23 97
-	-	62 658.0	-	-	-	2 124.0	1 082.0	3 186.0	69 030
-	-	460.0	-	720.0	-	6.0	-	59.0	1 37
-	-	4 284.0	-	-	-	-	476.0	-	4 76
-	-	200.0	-	-	-	120.0	16.0	-	33
-	-	230.0	-	-	-	-	31.0	-	26
-	-	43.0	-	0.5	-	9.8	11.2	-	11
-	-	1.1	-	-	-	-	0.1	-	[illegible]
-	-	-	-	-	-	-	1 631.0	-	1 63
888.0	2 286.0	91 820.1	1 437.0	3 384.5	-	2 392.8	9 172.8	3 504.0	145 47
-	1 470.0	-	198.0	20.0	-	-	147.0	49.0	2 76
-	460.0	46.0	74.0	-	-	-	575.0	-	1 35
-	400.0	2 150.0	900.0	-	-	20.0	5 000.0	150.0	9 02
-	216.0	-	-	-	-	-	14 400.0	-	14 61
-	150.0	25.0	12.5	-	-	-	12.5	15.0	21
-	755.0	902.5	-	-	-	0.8	245.0	16.25	3 00
-	-	-	1 250.0	-	-	25.0	1 625.0	75.0	3 00
12.0	234.0	-	45.0	-	-	6.0	342.0	30.0	2 4
-	112.0	108.5	53.5	159.5	-	0.6	-	-	81
-	40.0	-	2.5	-	-	-	4.5	-	5

SECTION 2

Plain sheet/strips coated sheets

...d	Hot rolled	Galvanised	Tinned	Wires	Bars/ rods	Pipes/ tubes	Total
6.0	-	2 664.0	-	-	2 220.0	266.0	23 976.0
8.0	-	-	-	2 124.0	1 062.0	3 166.0	69 030.0
0.0	-	720.0	-	6.0	-	59.0	1 376.0
4.0	-	-	-	-	476.0	-	4 760.0
0.0	-	-	-	120.0	16.0	-	536.0
0.0	-	-	-	-	31.0	-	261.0
5.0	-	0.5	-	9.8	11.2	-	116.5
1.1	-	-	-	-	0.1	-	1.2
-	-	-	-	-	1 631.0	-	1 631.0
0.1	1 437.0	3 384.5	-	2 392.8	9 172.8	3 504.0	145 479.2
-	196.0	20.0	-	-	147.0	49.0	2 764.0
6.0	74.0	-	-	-	573.0	-	1 380.0
0.0	900.0	-	-	20.0	5 000.0	150.0	9 080.0
	-	-	-	-	14 400.0	-	14 616.0
5.0	12.5	-	-	-	12.5	15.0	215.0
2.5	-	-	-	0.8	245.0	16.25	3 002.05
	1 250.0	-	-	25.0	1 625.0	75.0	3 000.0
	45.0	-	-	6.0	342.0	30.0	2 430.0
3.5	55.5	159.5	-	0.6	-	-	810.1
	2.5	-	-	-	4.5	-	30.4

SECTION 3

Item	Unit of output	Anticipated output	Structurals				Plates
			Beams	Channels	Angles	Tees	
C. Industrial and agricultural (cont'd)							
37. Other material handling equipment (conveying machinery)	Mill Rials	150.0	39.0	117.0	211.0	-	399.0
38. Industrial boilers	Mill Rials	500.0	-	-	65.0	-	2 600.0
39. Air compressors	Mill Rials	350.0	-	-	10.0	-	131.0
40. Power driven pumps (Turbine and centrifugal)	No	75 000.0	-	-	-	-	-
41. Textile machinery	Mill Rials	4 500.0	1 841.0	977.0	1 395.0	-	13 960.0
42. Sugar machinery	Mill Rials	480.0	380.0	380.0	192.0	-	192.0
43. Cement machinery	Mill Rials	520.0	445.0	157.0	222.0	-	3 150.0
44. Equipment for chemical industry	ton	50 000.0	1 300.0	1 400.0	1 000.0	200.0	19 000.0
45. Heavy plates and vessels works	ton	4 600.0	32.0	32.0	78.0	4.6	4 000.0
46. Machine tools	Mill Rials	450.0	6.7	6.7	90.0	-	198.0
47. Machine tool accessories	Mill Rials	15.0	-	-	-	-	-
48. Hand tools	ton	4 500.0	-	-	-	-	-
49. Dumpers and scrapers	No	600.0	30.0	120.0	90.0	-	3 300.0
50. Shovels and excavators	No	40.0	-	-	-	-	720.0
51. Road rollers	No	400.0	-	40.0	20.0	-	2 600.0
52. Dairy machinery	Mill Rials	50.0	-	17.5	3.5	-	9.0
	Sub-total C		4 321.2	5 312.4	5 795.7	216.6	54 066.0
D. Metal products							
53. Steel furniture	ton	47 500.0	-	-	2 043.0	-	525.0
54. Steel wire ropes and chains	ton	3 000.0	-	-	-	-	-
55. Expanded metal	ton	1 300.0	-	-	-	-	-
56. Bolts, nuts and rivets	ton	12 500.0	-	-	-	-	-

SECTION 1

Appendix

…ructurals				Plain sheet/strips coated sheets						
…els	Angles	Tees	Plates	Cold rolled	Hot rolled	Galvanised	Tinned	Wires	Bars/rods	Pi… tu…
.0	211.0	-	399.0	255.0	-	-	-	-	70.0	
	65.0	-	2 600.0	-	-	-	-	-	65.0	2 1
	10.0	-	151.0	-	5.5	-	-	-	105.0	1
	-	-	-	-	-	-	-	-	1 125.0	
7.0	1 595.0	-	15 950.0	324.0	371.0	-	-	2 790.0	5 580.0	2 7
.0	192.0	-	192.0	72.0	-	2.4	-	-	290.0	4
7.0	222.0	-	3 150.0	300.0	-	8.0	-	-	520.0	
.0	1 000.0	200.0	19 000.0	7 500.0	940.0	10.0	-	-	6 750.0	1 9
2.0	78.0	4.6	4 000.0	66.0	46.0	-	-	-	-	6
5.7	90.0	-	198.0	16.0	27.0	-	-	13.5	130.5	1
	-	-	-	-	-	-	-	-	60.0	
	-	-	-	-	-	-	-	-	3 915.0	
0.0	90.0	-	3 500.0	1 500.0	-	-	-	-	120.0	
	-	-	720.0	60.0	-	-	-	-	60.0	
0.0	20.0	-	2 600.0	-	32.0	-	-	-	192.0	
7.5	3.5	-	9.0	60.0	-	-	-	-	5.5	
2.4	5 795.7	216.6	54 086.0	15 540.0	3 955.0	199.9	-	2 855.9	41 339.0	9 5
	2 043.0	-	525.0	47 520.0	-	-	-	-	950.0	1 8
	-	-	-	-	-	-	-	5 800.0	-	
	-	-	-	-	1 450.0	-	-	-	-	
	-	-	-	-	-	-	-	5 600.0	15 000.0	

SECTION 2

- 9

Plain sheet/strips ...d	Hot rolled	Galvanised	Tinned	Wires	Bars/rods	Pipes/tubes	Total
5.0	-	-	-	-	70.0	282.0	1 353.0
	-	-	-	-	65.0	2 112.5	4 842.5
-	3.5	-	-	-	105.0	105.0	354.5
-	-	-	-	-	1 125.0	450.0	1 575.0
24.0	371.0	-	-	2 790.0	5 580.0	2 734.0	29 962.0
2.0	-	2.4	-	-	290.0	455.0	1 945.4
00.0	-	8.0	-	-	320.0	314.0	5 116.0
00.0	940.0	10.0	-	-	6 750.0	1 900.0	40 000.0
46.0	46.0	-	-	-	-	690.0	4 928.5
16.0	27.0	-	-	13.5	130.5	155.0	623.4
-	-	-	-	-	60.0	-	60.0
-	-	-	-	-	3 915.0	-	3 915.0
00.0	-	-	-	-	120.0	-	5 180.0
60.0	-	-	-	-	60.0	40.0	880.0
-	32.0	-	-	-	192.0	24.0	2 906.0
60.0	-	-	-	-	3.5	2.5	98.0
540.0	3 953.0	199.9	-	2 855.9	41 339.0	9 559.25	140 976.95
520.0	-	-	-	-	950.0	1 853.0	52 869.0
-	-	-	-	5 800.0	-	-	5 800.0
-	1 430.0	-	-	-	-	-	1 430.0
-	-	-	-	5 600.0	13 000.0	-	18 600.0

SECTION 3

Item	Unit of output	Anticipated output	Structurals				Plates
			Beams	Channels	Angles	Tees	
C. Industrial and agricultural machinery (cont'd)							
33. Stationary diesel engines	No	7 500	-	-	7.50	-	-
34. Cranes ..	ton	2 000	80.00	525.00	570.00	8.00	152.0
35. Passenger and industrial lifts ..	No	400	46.20	46.20	98.00	-	56.0
36. Fork lifts ..	-	-	-	-	-	-	-
37. Other matl handling eqpt (conveying machinery)	Mill Rials	100	23.50	78.30	140.90	-	266.2
38. Industrial boilers ..	Mill Rials	160	-	-	16.00	-	640.0
39. Air compressors ..	Mill Rials	200	-	-	4.50	-	59.8
40. Power driven pumps (turbine and centrifugal)	No	50 000	-	-	-	-	-
41. Textile machinery ..	Mill Rials	3 000	1 227.60	651.00	930.00	-	9 300.00
42. Sugar machinery ..	Mill Rials	300	240.00	240.00	120.00	-	1 300.0
43. Cement machinery ..	Mill Rials	325	280.00	98.00	140.00	-	1 950.00
44. Equipment for chemical industry ..	ton	32 000	832.00	896.00	640.00	128.00	12 160.00
45. Heavy plates and vessels	ton	3 300	23.00	23.00	56.00	3.30	2 900.00
46. Machine tools ..	Mill Rials	350	5.20	5.20	70.00	-	154.00
47. Machine tool accessories	Mill Rials	10	-	-	-	-	-
48. Hand tools ..	ton	3 000	-	-	-	-	-
49. Dumpers and scrapers ..	No	400	20.00	80.00	60.00	-	2 200.00
50. Shovels and excavators ..	No	25	-	-	-	-	450.00
51. Road rollers ..	No	250	-	25.00	12.50	-	1 625.00
52. Dairy machinery ..	Mill Rials	25	-	8.50	1.70	-	4.30
Sub-total C ..			2 802.50	3 261.5	3 256.50	139.30	34 351.80
D. Metal products							
53. Steel furniture ..	ton	27 000	-	-	1 155.80	-	295.70
54. Steel wire ropes and chains ..	-	-	-	-	-	-	-
55. Expanded metal ..	ton	750	-	-	-	-	-
56. Bolts, nuts and rivets ..	ton	10 000	-	-	-	-	-
57. Builders hardware ..	ton	4 200	-	-	-	-	-
58. Tanks ..	ton	18 380	-	-	2 750.00	-	16 500.00
59. Gas cylinders ..	No	600 000	-	-	-	-	-
60. Wire nails ..	ton	15 000	-	-	-	-	-
61. Wire netting and wire products ..	ton	3 112	-	-	-	-	-
62. Stoves ..	No	320 000	-	-	-	-	-
63. Sewing machines ..	No	100 000	-	-	-	-	10.00
64. Typewriters and office machines ..	-	-	-	-	-	-	-
65. Steel drums and containers ..	ton	21 000	-	-	-	-	-
66. Tin cans ..	ton	59 300	-	-	-	-	-
67. Arc welding electrodes ..	ton	29 000	-	-	-	-	-
68. Window and door frames ..	ton	128 000	-	-	5 495.00	-	1 278.00
69. Heavy pipes and tubes (for oil, gas and water)	ton	430 000	(150 000.00) a/	-	-	-	110 000.00
Sub-total D ..					9 408.00		128 083.70

SECTION 1

Item	Unit of output	Anticipated output	Structurals: Beams	Channels	Angles	Tees	Plates
D. Metal products (Cont'd)							
57. Builders hardware	Ton	10 000.0	-	-	-	-	-
58. Tanks	Nos	23 160.0	-	-	3 480.0	-	20 700.0
59. Gas cylinders	Nos	1 200 000.0	-	-	-	-	-
60. Wire nails	Ton	20 000.0	-	-	-	-	-
61. Wire netting and wire products	Ton	6 629.0	-	-	-	-	-
62. Stoves	Nos	550 000.0	-	-	-	-	-
63. Sewing machines	Nos	300 000.0	-	-	-	-	15.0
64. Typewriters and office machines	Nos	40 000.0	-	-	-	-	-
65. Steel drums and containers	Ton	30 000.0	-	-	-	-	-
66. Tin cans	Ton	75 000.0	-	-	-	-	-
67. Arc welding electrodes	Ton	40 000.0	-	-	-	-	-
68. Steel doors and windows	Ton	234 000.0	-	-	10 062.0	-	2 340.0
69. Heavy pipes and tubes (for oil, gas and water)	Ton	750 000.0	(260 000.0)a/	-	-	-	204 000.0
Sub-total					17 585.0	-	227 578.0

(a/ Semis for seamless tubes)

II. CONSTRUCTIONAL AND ALLIED ACTIVITIES

Item	Unit of output	Anticipated output	Beams	Channels	Angles	Tees	Plates
A. Large and medium industries and mining	Mill Rials of total outlay	45 496.0	36 356.0	40 900.0	63 474.0	-	36 356.0
B. Agriculture and allied activities	Mill Rials of total outlay	8 600.0	3 434.0	6 010.0	3 005.0	217.0	217.0
C. Oil and gas	Mill Rials of total outlay	19 400.0	3 890.0	7 779.0	7 779.0	486.0	1 945.0
Sub-total A to C			43 680.0	54 689.0	74 258.0	705.0	38 518.0

SECTION 1

rals			Plain sheet/strips coated sheets						
Angles	Tees	Plates	Cold rolled	Hot rolled	Galvanized	Tinned	Wires	Bars and rods	Pipes and tub
-	-	-	4 220.0	-	-	-	-	1 610.0	-
5 480.0	-	20 700.0	-	2 400.0	-	-	-	-	-
-	-	-	21 600.0	-	-	-	-	1 200.0	1 200.
-	-	-	-	-	-	-	-	21 600.0	-
-	-	-	-	-	-	-	7 200.0	-	-
-	-	-	8 500.0	-	-	-	-	1 700.0	-
-	-	15.0	150.0	-	-	-	-	525.0	-
-	-	-	580.0	-	-	-	-	140.0	-
-	-	-	38 280.0	-	-	-	-	-	-
-	-	-	-	-	-	82 390.0	-	-	-
-	-	-	-	-	-	-	-	30 000.0	-
10 062.0	-	2 340.0	234 000.0	-	-	-	-	4 880.0	9 360.
-	-	204 000.0	-	469 000.0	-	-	-	-	-
17 585.0	-	227 578.0	354 850.0	472 850.0	-	82 390.0	18 300.0	75 405.0	12 413.

ls for seamless tubes)

63 474.0	-	36 356.0	-	31 812.0	68 168.0	-	-	5 811.0	10 877.
3 005.0	217.0	217.0	-	129.0	7 208.0	-	-	12 879.0	12 879.
7 779.0	486.0	1 945.0	-	196.0	972.0	-	-	6 134.0	1 047.
74 258.0	703.0	38 518.0	-	32 136.0	76 348.0	-	-	24 824.0	24 803.

SECTION 2

	Plain sheet/strips coated sheets						
ld led	Hot rolled	Galvanised	Tinned	Wires	Bars and rods	Pipes and tubes	Total
20.0	-	-	-	-	1 610.0	-	5 850.0
	2 400.0	-	-	-	-	-	28 580.0
00.0	-	-	-	-	1 200.0	1 200.0	24 000.0
	-	-	-	-	21 600.0	-	21 600.0
	-	-	-	7 200.0	-	-	7 200.0
00.0	-	-	-	-	1 700.0	-	10 200.0
50.0	-	-	-	-	525.0	-	690.0
80.0	-	-	-	-	140.0	-	720.0
80.0	-	-	-	-	-	-	38 280.0
	-	-	82 390.0	-	-	-	82 390.0
	-	-	-	-	30 000.0	-	30 000.0
00.0	-	-	-	-	4 680.0	9 360.0	260 442.0
-	469 000.0	-	-	-	-	-	673 000.0
50.0	472 850.0	-	82 390.0	18 300.0	75 405.0	12 413.0	1 261 351.0
-	31 812.0	68 168.0	-	-	5 811.0	10 877.0	295 754.0
-	129.0	7 208.0	-	-	12 879.0	12 879.0	45 978.0
-	196.0	972.0	-	-	6 134.0	1 047.0	30 227.0
-	32 136.0	76 348.0	-	-	24 824.0	24 803.0	369 959.0

SECTION 3

II. Constructional and allied activities (Cont'd)

	Item	Unit of output	Anticipated output	Structurals: Beams	Channels	Angles	Tees	Plates
D.	Irrigation	Mill Rials of total outlay	19 400.0	17 458.0	2 904.0	4 367.0	290.0	21 412.0
E.	Roads and bridges	Mill Rials of total outlay	8 950.0	3 077.0	972.0	1 779.0	-	-
F.	Social services	Mill Rials of total outlay	53 100.0	102 216.0	16 536.0	8 614.0	1 654.0	-
G.	Telecommunications (Post, telegraph, telephones and radio)	Mill Rials of total outlay	1 900.0	248.0	7 020.0	3 802.0	-	-
H.	Airports	Mill Rials of total outlay	1 180.0	122.0	71.0	301.0	-	-
I.	Ports and harbours	Mill Rials of total outlay	5 440.0	4 806.0	1 716.0	12 012.0	7 550.0	12 012.0
	Sub-total D to I			127 921.0	29 219.0	31 875.0	9 494.0	33 424.0
J.	**Power supply**							
	Generation							
	a) Hydel	MW	485.0	5 820.0	1 358.0	1 629.6	29.1	5 432.0
	b) Thermal	MW	60.0	516.0	126.0	144.0	2.4	480.0
	Transmission							
	a) 400 kV	Km	300.0	-	-	4 320.0	-	240.0
	b) 230 kV	Km	800.0	-	-	6 570.0	-	365.0
	c) 132 kV	Km	310.0	-	-	3 200.0	-	180.0
	Distribution	Million Rials of total outlay	1 610.0	-	-	6 570.0	-	365.0
	Sub-total J			6 336.0	1 484.0	22 433.6	31.5	7 062.0

SECTION 1

...als			Plain sheet/strips coated sheets						
Angles	Tees	Plates	Cold rolled	Hot rolled	Galvanised	Tinned	Wire	Bars and rods	Pipes and tubes
4 367.0	290.0	21 412.0	582.0	1 452.0	5 820.0	-	-	91 690.0	-
1 779.0	-	-	-	3 862.0	11 205.0	-	-	106 390.0	-
8 614.0	1 654.0	-	-	9 268.0	30 458.0	-	3 310.0	142 288.0	72 928.0
3 802.0	-	-	-	13 306.0	1 901.0	-	-	20 304.0	-
301.0	-	-	-	365.0	1 220.0	-	-	9 713.0	-
12 012.0	7 550.0	12 012.0	-	-	17 446.0	-	-	31 605.0	-
31 875.0	9 494.0	33 424.0	582.0	28 253.0	68 048.0	-	3 310.0	401 988.0	72 928.0
1 629.6	29.1	5 452.0	-	271.6	543.2	-	-	15 500.0	1 750.0
144.0	2.4	480.0	-	24.0	48.0	-	-	1 850.0	156.0
4 320.0	-	240.0	-	-	-	-	-	240.0	-
6 570.0	-	365.0	-	-	-	-	-	365.0	-
3 200.0	-	180.0	-	-	-	-	-	180.0	-
6 570.0	-	365.0	-	-	-	-	-	365.0	-
22 433.6	31.5	7 062.0	-	295.6	591.2	-	-	18 480.0	1 906.0

SECTION 2

Plain sheet/strips coated sheets							
Cold rolled	Hot rolled	Galvanised	Tinned	Wires	Bars and rods	Pipes and tubes	Total
82.0	1 452.0	5 820.0	-	-	91 690.0	-	145 975.0
-	3 862.0	11 205.0	-	-	106 390.0	-	128 283.0
-	9 268.0	30 458.0	-	3 310.0	142 288.0	72 928.0	387 272.0
-	13 306.0	1 901.0	-	-	20 304.0	-	46 576.0
-	365.0	1 220.0	-	-	9 713.0	-	11 792.0
-	-	17 446.0	-	-	31 605.0	-	87 144.0
582.0	28 255.0	68 048.0	-	3 310.0	401 988.0	72 928.0	807 042.0
-	271.6	543.2	-	-	15 500.0	1 750.0	32 334.0
-	24.0	48.0	-	-	1 830.0	156.0	3 326.0
-	-	-	-	-	240.0	-	4 800.0
-	-	-	-	-	365.0	-	7 300.0
-	-	-	-	-	180.0	-	3 560.0
-	-	-	-	-	365.0	-	7 300.0
-	295.6	591.2	-	-	18 480.0	1 906.0	58 620.0

SECTION 3

Item	Unit of output	Antici-pated output	Structurals Beams	Channels	Angles	Tees	Plates	C ro
II. CONSTRUCTIONAL AND ALLIED ACTIVITIES (Cont'd)								
K. Transport								
New lines, signalling and safety works	Km	600.0	180.0	180.0	340.0	20.0	1 800.0	
Track removal	Km	136.0	-	-	-	-	-	
Electrification	Km	300.0	5 100.0	2 400.0	1 858.0	98.0	240.0	
Maintenance	Nos	4 400.0	-	88.0	88.0	-	220.0	
Sub-total K			5 280.0	2 668.0	2 286.0	118.0	2 260.0	
Total			188 126.2	102 474.4	191 636.3	11 696.1	419 337.0	673

Item	Unit of output	Antic ou
Transport (Cont'd)		
New lines, signalling and safety works	Km	6
Track removal	Km	1
Electrification	km	3
Maintenance (wagons only)	Nos	4 4
Sub-total K (Cont'd)		
Total		
Grand total		
Semis a/		

a/ Semis for seamless tubes

SECTION 1

	...cturals			Plain sheet/strips coated sheets						Pipe tube
	Angles	Tees	Plates	Cold rolled	Hot rolled	Galvanised	Tinned	Wires	Bars/rods	
0	340.0	20.0	1 800.0	-	1 800.0	-	-	5 400.0	1 800.0	900
	-	-	-	-	-	-	-	-	-	-
0	1 858.0	98.0	240.0	-	18.0	-	-	90.0	1 500.0	300
0	88.0	-	220.0	-	1 540.0	-	-	-	220.0	110
0	2 286.0	118.0	2 260.0		3 358.0			5 490.0	3 520.0	1 31
4	191 636.3	11 696.1	419 337.0	673 461.1	567 364.6	154 241.6	82 390.0	34 210.7	613 330.8	138 097

Unit of output	Anticipated output	Rails	Fish plates	Fish bolts	Sleepers	Dog spikes	Points crossi
Km	600.0	51 000.0	2 400.0	600.0	43 200.0	900.0	2 10
Km	136.0	10 680.0	272.0	68.0	9 810.0	-	-
km	300.0	-	-	-	-	-	-
Nos	4 400.0	-	-	-	-	-	-
		61 680.0	2 672.0	668.0	53 010.0	900.0	2 10

SECTION 2

Plain sheet/strip coated sheets: Cold rolled	Hot rolled	Galvanized	Tinned	Wires	Bars/rods	Pipes/tubes	Total
-	1 800.0	-	-	5 400.0	1 800.0	900.0	12 480.0
-	-	-	-	-	-	-	-
-	18.0	-	-	90.0	1 500.0	300.0	11 604.0
-	1 540.0	-	-	-	220.0	110.0	2 266.0
	3 358.0			5 490.0	3 520.0	1 310.0	26 290.0
73 461.1	567 364.6	154 241.6	82 390.0	34 210.7	[illegible]	[illegible]	[illegible]

Anticipated output	Rails	Fish plates	Fish bolts	Sleepers	Dog spikes	Points and crossings	Total
600.0	51 000.0	2 400.0	600.0	43 200.0	900.0	2 100.0	100 200.0
136.0	10 680.0	272.0	68.0	9 810.0	-	-	20 830.0
300.0	-	-	-	-	-	-	-
4 400.0	-	-	-	-	-	-	-
	61 680.0	2 672.0	668.0	53 010.0	900.0	2 100.0	121 030.0
							260,000.0
							[illegible]

SECTION 3

Appendix 6-13

FORECAST BY ALTERNATIVE METHODS

Forecasts of the demand for steel consuming items for which suitable series could be developed were also arrived at on the basis of time-trend and regression analysis. In case of regression, only simple regression analysis correlating the past data with the independent variable was carried out. In order to determine the nature of the equation representing the past consumption, the following method was adopted:

i) past availability data for each year was plotted against the year in case of time-trend analysis and against the selected independent variable in case of regression analysis;

ii) two representative lines, the least square straightline and the least square parabola, were drawn;

iii) deviations D1, D2, D3 etc of the lines from the actual points were measured;

iv) value of $D1^2 + D2^2 + D3^2 \ldots\ldots + Dn^2$ was calculated; and

v) the line showing lower value of $\sum Dn^2$ was chosen as the best fitting line.

	Structurals			Plates	Plain sheets/strips		Coated sheets		Wires	Bars/rods	
eams	Channels	Angles	Tees		C.rolled	H.rolled	Galvanised	Tinned			
-	-	7.50	-	-	-	375.00	-	-	7.50	487.50	
).00	525.00	570.00	8.00	152.00	-	30.00	-	-	4.00	225.00	
.20	46.20	98.00	-	56.00	51.80	26.60	79.80	-	0.30	-	
-	-	-	-	-	-	-	-	-	-	-	
3.50	78.30	140.90	-	266.20	156.60	-	-	-	-	47.00	
-	-	16.00	-	640.00	-	-	-	-	-	16.00	
-	-	4.50	-	59.80	-	1.60	-	-	-	48.00	
-	-	-	-	-	-	-	-	-	-	750.00	
7.60	651.00	930.00	-	9 300.00	215.80	247.40	-	-	1 860.00	3 720.00	1
0.00	240.00	120.00	-	1 200.00	45.00	-	1.50	-	-	180.00	
0.00	98.00	140.00	-	1 950.00	186.00	-	5.00	-	-	325.00	
2.00	896.00	640.00	128.00	12 160.00	4 800.00	601.60	6.40	-	-	4 320.00	1
.00	23.00	56.00	3.30	2 900.00	33.00	33.00	-	-	-	-	
.20	5.20	70.00	-	154.00	15.70	21.00	-	-	10.50	101.50	
-	-	-	-	-	-	-	-	-	-	40.00	
-	-	-	-	-	-	-	-	-	-	2 600.00	
0.00	80.00	60.00	-	2 200.00	1 000.00	-	-	-	-	80.00	
-	-	-	-	450.00	37.50	-	-	-	-	37.50	
	25.00	12.50	-	1 625.00	-	20.00	-	-	-	120.00	
-	8.50	1.70	-	4.30	29.00	-	-	-	-	2.60	
2.50	3 261.5	3 256.50	139.30	34 351.80	8 225.40	1 871.80	94.00		1 892.90	25 167.60	5
	-	1 155.80	-	295.70	26 880.00	-	-	-	-	537.60	1
	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	825.00	-	-	-	-	
	-	-	-	-	-	-	-	-	4 500.00	10 500.00	
	-	-	-	-	3 165.00	-	-	-	-	1 207.50	
	-	2 750.00	-	16 500.00	-	1 838.00	-	-	-	-	
	-	-	-	-	10 800.00	-	-	-	-	600.00	
	-	-	-	-	-	-	-	-	-	16 200.00	
	-	-	-	-	-	-	-	-	3 450.00	-	
	-	-	-	-	4 800.00	-	-	-	-	960.00	
	-	-	-	10.00	100.00	100.00	-	-	-	350.00	
	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	26 796.00	-	-	-	-	-	
	-	-	-	-	-	-	-	66 000.00	-	-	
	-	-	-	-	-	-	-	-	-	21 750.00	
	-	5 495.00	-	1 278.00	127 800.00	-	-	-	-	2 556.00	5 1
)00.00) a/	-	-	-	110 000.00	-	255 000.00	-	-	-	-	
		9 408.00		128 083.70	200 341.00	257 763.00		66 000.00	7 950.00	54 661.10	6

SECTION 2

Appendix 6-13 (continued)

Example

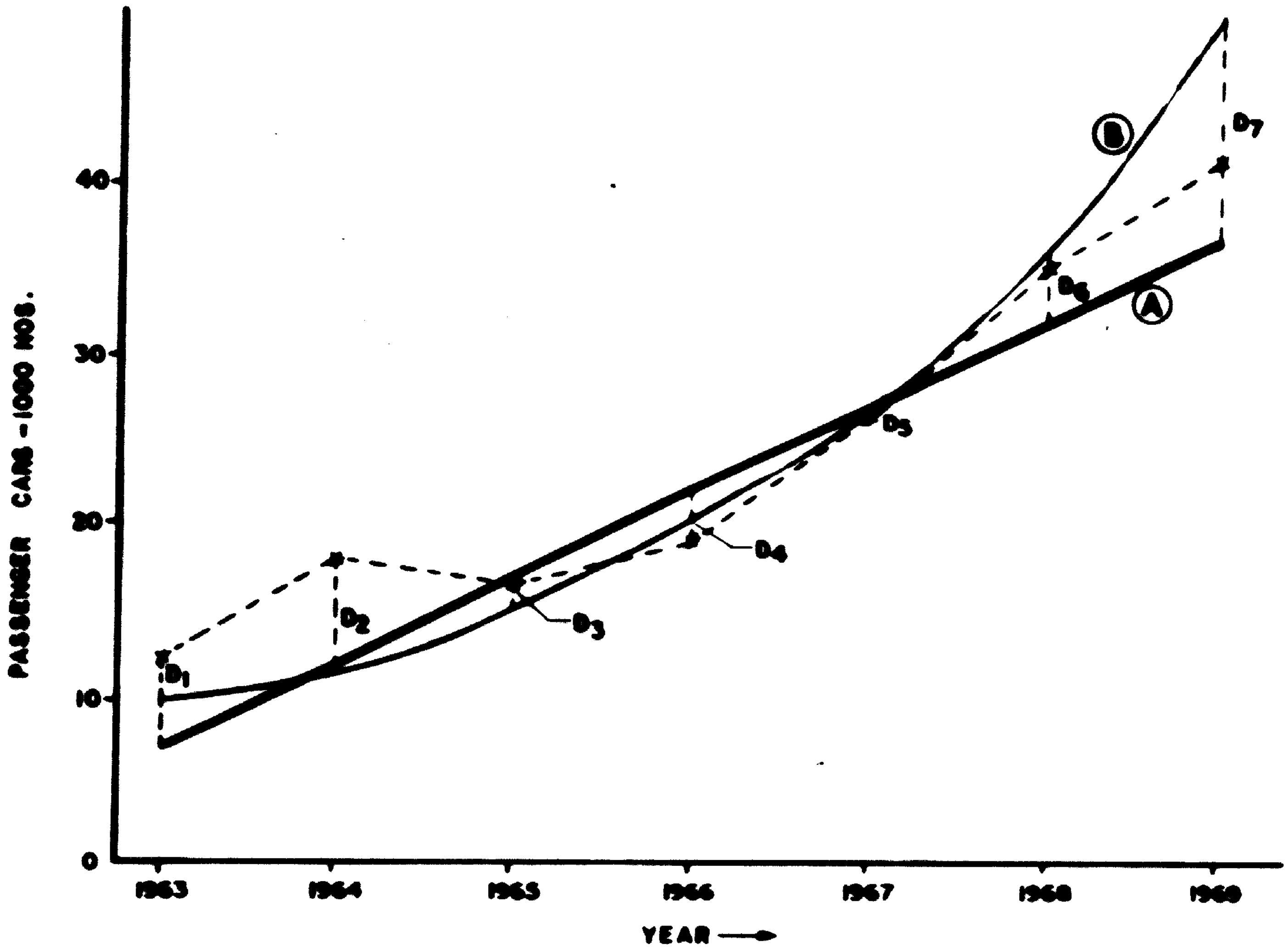
Passenger cars: time-trend analysis - Past availability in each year was plotted in a squared paper and two apparently representative lines were drawn as shown in Fig. 6-13-1. Line A represents the least square straight line and line B is the least square parabola. Deviations of each line from the actual points were measured. The value of $\sum Dn^2$ for line A and line B are 97×10^6 and 135.75×10^6 respectively. Therefore, the straight line A is the best fitting line represented by the equation

$$Y = a_o + a_1 t$$

where t is the number of years. In this particular case, $a_o = 24,216$ and $a_1 = 3,900$ so that the equation becomes

$$Y = 24,216 + 3,900t$$

Passenger cars: regression analysis - Past availability in each year was plotted against per capita income, the selected economic indicator for the corresponding year. Two representative lines, the least square straight line denoted by A and the least square parabola denoted by B, are drawn as shown in Fig. 6-13-2. Deviations of each line from the actual points were measured. The value of $\sum Dn^2$ for line A and line B are 54×10^6 and 43×10^6 respectively. Therefore, line B with the lower value for $\sum Dn^2$ is chosen as the best



Deviations of Curve A

$D_{1a} = 6000$, $D_{2a} = 6000$,
$D_{3a} = 0$, $D_{4a} = 3000$, $D_{5a} = 0$,
$D_{6a} = 3000$ and $D_{7a} = 4000$

$\sum D_{na}^2 = 97 \times 10^6$.

Deviations of Curve B

$D_{1b} = 4000$, $D_{2b} = 6000$,
$D_{3b} = 3000$, $D_{4b} = 3000$,
$D_{5b} = 0$, $D_{6b} = 500$,
$D_{7b} = 8000$

$\sum D_{nb}^2 = 136 \times 10^6$

$\sum D_{na}^2$ being less than $\sum D_{nb}^2$,
A is the better fitting curve.

FIG. 6-13-1. PASSENEGER CARS: ANNUAL AVAILABILITY, 1963-1969

Deviations of Curve A

$D_{1A} = 0$, $D_{2A} = 5000$, $D_{3A} = 0$, $D_{4A} = 2000$, $D_{5A} = 3000$, $D_{6A} = 3000$, $D_{7A} = 4000$

$\sum D_{nA}^2 = 54 \times 10^6$

Deviations of Curve B

$D_{1B} = 0$, $D_{2B} = 5000$, $D_{3B} = 2000$, $D_{4B} = 1000$, $D_{5B} = 2000$, $D_{6B} = 3000$, $D_{7B} = 0$.

$\sum D_{nB}^2 = 43 \times 10^6$

$\sum D_{nB}^2$ being less than $\sum D_{nA}^2$, B is the better fitting curve.

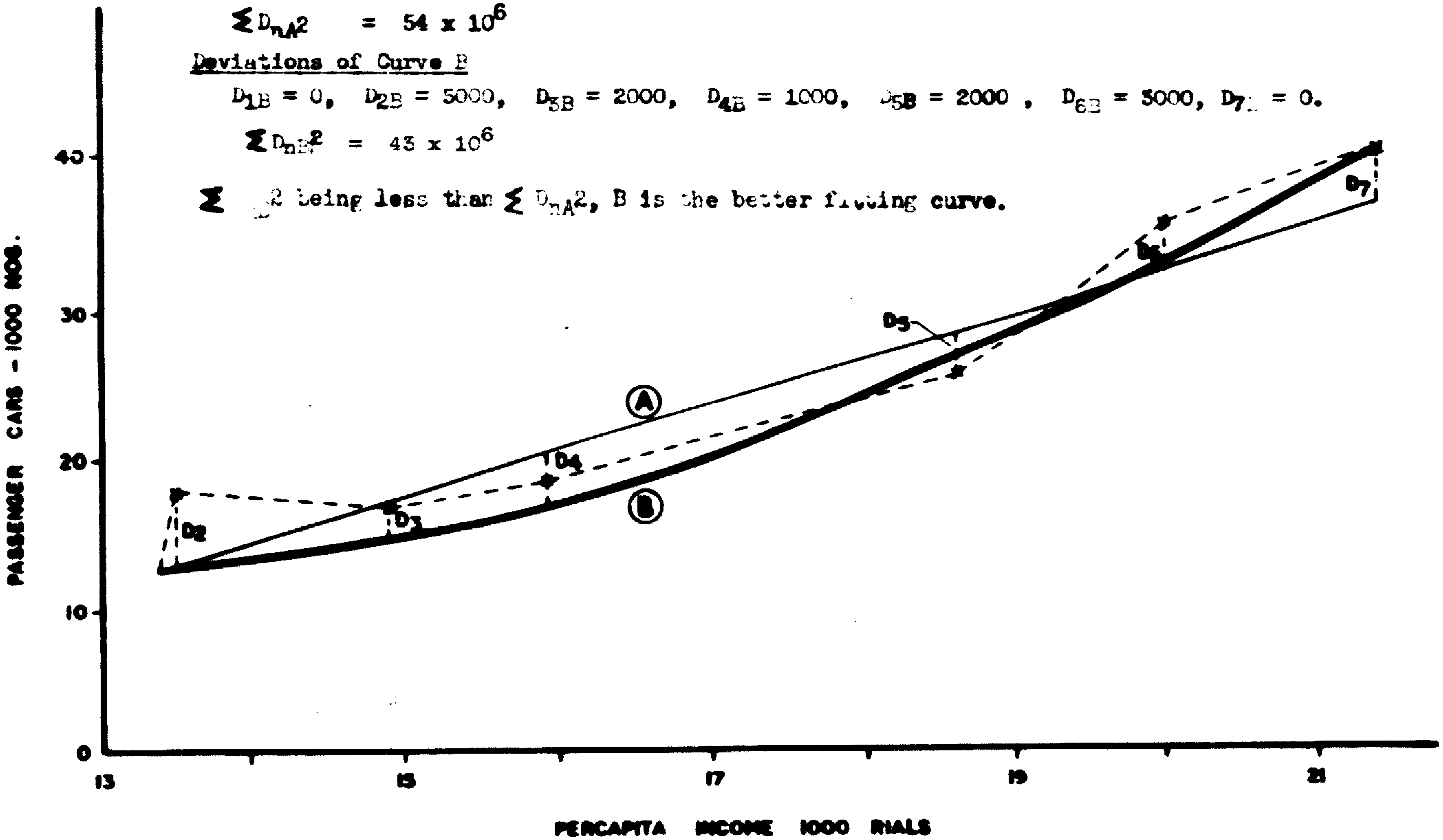


FIG. 6-13-2. PASSENGER CARS VS PERCAPITA INCOME

Appendix 6-13 (continued)

fitting curve and the corresponding equation is

$$Y = a_0 + a_1 x + a_2 x^2$$

where x is the per capita income.

In this particular case $a_0 = -7,526$, $a1 = 1,720$ and $a_2 = 69$ so that the equation becomes

$$Y = -7,526 + 1,720 x + 69 x^2$$

As in the case of passenger cars, the nature of the equation representing the best fitting line/curve has been determined for each item.

A. Transport equipment

Buses and mini-buses

The output level of buses and mini-buses were estimated by time-trend and regression methods.

Time-trend analysis

The appropriate time-trend equation fitted for buses and mini-buses on the basis of past data and worked out parameters is

$$Y = 2,283 + 772t + 123t^2$$

where t represents the time. Details of the mathematical model are given in Appendix 6-14.

The projected values derived from this equation are given in Table 6-13-1.

Appendix 6-13 (continued)

Table 6-13-1

BUSES AND MINI-BUSES: FORECAST BY TIME-TREND ANALYSIS

Year	t	772t	$123t^2$	Y Nos
1972	6	4 632	4 400	11 315
1977	11	8 492	14 600	25 375
1982	16	12 352	31 500	46 135

The output levels of buses were also estimated by

Regression regression techniques. The output level is correlated with population as transport facilities needed would depend on the passenger traffic which in turn is related to population. The equation thus derived is

$$Y = 34,000 + 730x + 30x^2$$

where x is the population. The details of the mathematical model are given in Appendix 6-15 and the projections made with this equation are given in Table 6-13-2.

Table 6-13-2

BUSES AND MINI-BUSES: FORECAST BY REGRESSION TECHNIQUE

Year	x a/ (million)	730x	$30x^2$	Y Nos
1972	30.455	21 200	27 000	14 200
1977	35.50	24 000	36 000	26 000
1982	40.30	30 200	48 600	44 800

a/ Population x has been estimated by the exponential formula $P = Poe^{rn}$
where Po is the present population, r is the population growth rate per year, n is the number of years and P is the population in the n^{th} year.

Appendix 6-13 (continued)

The output level has also been calculated on the basis of the compound equation

$$Cn = Co \ (1+P)^n$$

where Cn is level in the n^{th} year, Co is initial level, P is the growth rate and n is the span of years. The projected values derived on the basis of this equation are given in Table 6-13-3.

Table 6-13-3

BUSES AND MINI-BUSES: FORECAST BY COMPOUND EQUATION

Year	P	n	Base year	Co	Cn
1972	20%	5	1967	4 300	11 000
1977	15%	5	1972	11 000	22 000
1982	10%	5	1977	22 000	35 200

Passenger cars

The output levels of passenger cars were also calculated by time-trend and regression methods.

Time-trend analysis

The appropriate time-trend equation obtained from the past availability is

$$Y = 24,216 + 3,900t$$

where t is the time. Details of the mathematical model are given in Appendix 6-16 and the forecasts derived on the basis of this equation are shown in Table 6-13-4.

Appendix 6-13 (continued)

Table 6-13-4

PASSENGER CARS: FORECAST BY TIME-TREND ANALYSIS

Year	t	3 900t	Y Nos
1972	6	23 400	47 616
1977	11	42 900	67 116
1982	16	62 400	86 616

Regression

For evolving the regression equation, the economic indicator chosen as independent variable is per capita income. On the basis of past availability of passenger cars and per capita income given in Appendix 6-17, the regression equation derived is

$$Y = -7,526 + 1,720x + 69x^2$$

where x is the per capita income. The output levels calculated from this equation are given in Table 6-13-5.

Table 6-13-5

PASSENGER CARS: FORECAST BY REGRESSION ANALYSIS

Year	x a/ '000 Rials	1 720x	$69x^2$	Y Nos
1972	25.7	44 204	45 574	82 252
1977	33.3	57 276	76 513	126 263
1982	41.8	71 896	120 560	184 930

a/ Per capita income has been calculated on the basis of expected population and national income for the years 1972, 1977 and 1982.

Appendix 6-13 (continued)

Trucks

Time-trend analysis

The appropriate equation derived on the basis of past availability, the detailed mathematical model of which is given in Appendix 6-18, is

$$Y = 3,008 + 650t + 54t^2$$

The projections obtained with this equation are given in Table 6-13-6.

Table 6-13-6

TRUCKS: FORECAST BY TIME-TREND ANALYSIS

Year	t	650t	$54t^2$	Y Nos
1972	6	3 900	1 940	8 850
1977	11	7 150	6 530	16 690
1982	16	10 400	13 820	27 230

Regression analysis

For regression equation, the independent variable chosen is index of industrial production. The equation derived is

$$Y = -3,429 + 44x$$

the details of which are given in Appendix 6-19. The projections derived from the regression equation are given in Table 6-13-7.

Table 6-13-7

TRUCKS: FORECAST BY REGRESSION ANALYSIS

Year	x a/ Nos	44x	Y Nos
1972	313.3	13 785	10 356
1977	551.4	24 262	20 833
1982	929.1	40 880	41 451

a/ The index of industrial production is estimated on the basis of growth rate of 13%, 12% and 11% between the periods 1967 to 1972, 1972 to 1977 and 1977 to 1982 taking 1967 as the base year.

Appendix 6-13 (continued)

Jeeps, station-wagons, ambulances and vannets

Time-trend analysis

Only time-trend analysis has been done as no indicator was found suitable for correlation and projection of this group as a whole by regression. The time-trend equation for jeeps and station-wagons is

$$Y = 1,663 + 655t + 172t^2$$

Details are given in Appendix 6-20. The projections on the basis of this equation are given in Table 6-13-8.

Table 6-13-8

JEEPS, STATION-WAGONS, AMBULANCES AND VANNETS: FORECAST BY TIME-TREND ANALYSIS

Year	t	655t	t^2	$172t^2$	Y Nos
1972	6	3 930	36	6 200	11 793
1977	11	7 205	121	20 800	29 639
1982	16	10 480	256	44 000	56 143

Motor cycles, scooters and mopeds

Time-trend analysis

Time-trend analysis are on mopeds as one group and motor cycles and scooters separately as another group. The past availability and the time scales are given in Appendices 6-21 and 6-22. The equations derived are as follows:

Mopeds : $Y = 301 + 180t + 39t^2$ (Appendix 6-21)

Motor cycles and scooters: $Y = 1,053 + 380t$ (Appendix 6-22)

The projections derived on the basis of these equations are given in Tables 6-13-9 and 6-13-10.

Appendix 6-13 (continued)

Table 6-13-9

MOPEDS: FORECAST BY TIME-TREND ANALYSIS

Year	t	180t	t^2	$39t^2$	Y Nos
1972	7	1 260	49	1 920	3 481
1977	12	2 160	144	5 600	8 061
1982	17	3 060	289	11 500	14 861

Table 6-13-10

MOTOR CYCLES AND SCOOTERS: FORECAST BY TIME-TREND ANALYSIS

Year	t	380t	Y Nos
1972	7	2 660	3 713
1977	12	4 560	5 613
1982	17	6 460	7 513

Projection for motor cycles, scooters and mopeds

From the above tables, the combined projections for motor cycles, scooters and mopeds are given in Table 6-13-11.

Table 6-13-11

FORECAST OF MOTOR CYCLES, SCOOTERS AND MOPEDS

Year	Motor cycles and scooters Nos	Mopeds Nos	Total Nos
1972	3 713	3 481	7 194
1977	5 613	8 061	13 674
1982	7 513	14 861	22 374

Automobile ancillaries

Time-trend analysis

The time-trend analysis on automobile ancillaries resulted in the equation

$$Y = 935.4 + 133t$$

lain sheets/strips		Coated sheets			Bars/	Pipes/	
.rolled	H.rolled	Galvanised	Tinned	Wires	rods	tubes	Total
-	375.00	-	-	7.50	487.50	22.50	900.00
-	30.00	-	-	4.00	225.00	20.00	1 614.00
51.80	26.60	79.80	-	0.30	-	-	404.90
-	-	-	-	-	-	-	-
156.60	-	-	-	-	47.00	266.20	978.70
-	-	-	-	-	16.00	528.00	1 200.00
-	1.60	-	-	-	48.00	48.00	161.90
-	-	-	-	-	750.00	300.00	1 060.00
215.80	247.40	-	-	1 860.00	3 720.00	1 822.80	19 974.60
45.00	-	1.50	-	-	180.00	270.00	2 296.50
186.00	-	5.00	-	-	325.00	185.00	3 169.00
4 800.00	601.60	6.40	-	-	4 320.00	1 216.00	25 600.00
33.00	33.00	-	-	-	-	495.00	3 566.30
15.70	21.00	-	-	10.50	101.50	105.00	488.10
-	-	-	-	-	40.00	-	40.00
-	-	-	-	-	2 600.00	-	2 600.00
1 000.00	-	-	-	-	80.00	-	3 440.00
37.50	-	-	-	-	37.50	25.00	550.00
-	20.00	-	-	-	120.00	15.00	1 817.50
29.00	-	-	-	-	2.60	1.20	47.30
8 225.40	1 871.80	94.00		1 892.90	25 167.60	5 407.90	86 471.20
6 880.00	-	-	-	-	537.60	1 048.30	29 917.40
-	-	-	-	-	-	-	-
-	825.00	-	-	-	-	-	825.00
-	-	-	-	4 500.00	10 500.00	-	15 000.00
3 165.00	-	-	-	-	1 207.50	-	4 372.50
-	1 838.00	-	-	-	-	-	21 088.00
0 800.00	-	-	-	-	600.00	600.00	12 000.00
-	-	-	-	-	16 200.00	-	16 200.00
-	-	-	-	3 450.00	-	-	3 450.00
4 800.00	-	-	-	-	960.00	-	5 760.00
100.00	100.00	-	-	-	350.00	-	560.00
-	-	-	-	-	-	-	-
6 796.00	-	-	-	-	-	-	26 796.00
-	-	-	66 000.00	-	-	-	66 000.00
-	-	-	-	-	21 750.00	-	21 750.00
7 800.00	-	-	-	-	2 556.00	5 112.00	142 241.00
-	255 000.00	-	-	-	-	-	365 000.00
0 341.00	257 763.00		66 000.00	7 950.00	54 661.10	6 760.30	730 959.90

SECTION 3

Appendix 6-13 (continued)

the details of which are given in Appendix 6-23. The projections made on the basis of the equation are given in Table 6-13-12.

Table 6-13-12

AUTOMOBILE ANCILLARIES: FORECAST BY TIME-TREND ANALYSIS

Year	t	133t	Y million Rials
1972	7	931	1 866.4
1977	12	1 596	2 531.4
1982	17	2 261	3 196.4

Bicycles complete

On the basis of past availability, the time-trend equation derived is

Time-trend analysis

$$Y = 84,117 + 4,900t$$

the details of which are given in Appendix 6-24. The projections derived by this equation are given in Table 6-13-13.

Table 6-13-13

BICYCLES: FORECAST BY TIME TREND ANALYSIS

Year	t	4 900t	Y Nos
1972	7	34 300	118 417
1977	12	58 500	142 917
1982	17	83 300	167 417

Appendix 6-13 (continued)

Regression analysis with per capita income as independent variable gave absurd results. They were therefore discarded.

Auto leaf-springs

Availability during the period 1962 to 1968 and the corresponding time-trend equation

Time-trend analysis

$$Y = 7,925 + 1,040t$$

are given in Appendix 6-25. The forecasts based on this equation are shown in Table 6-13-14.

Table 6-13-14

AUTO LEAF-SPRINGS: FORECAST BY TIME-TREND ANALYSIS a/

Year	t	1,040t	Y tons
1972	7	7 280	15 206
1977	12	12 480	20 406
1982	17	17 680	25 606

a/ The above estimates include requirement of spring for both maintenance and as original component. It is assumed that about 25% will be required for maintenance on the basis of information given by the manufacturers.

As no suitable indicator can be correlated, regression analysis has not been done.

Appendix 6-13 (continued)

B. Electrical equipment

Electrical transformers

Transformer demand comprises the following categories:

Power transformers

1) Used in transmission system
   i) Single step transmission transformer
   ii) Second step transmission transformer

2) Used in power house

Distribution transformers

1) Used for distribution system

2) Used by industrial consumers, supplied at voltage higher than 1,000 volts

Single step transmission transformers

The demand has been calculated on the basis of the well-known formula

F = [illegible]

where F = use factor = $\frac{\text{Total energy transferred in one year}}{\text{Transformer capacity (MVA)} \times 24 \times 365}$

A = energy transferred in one year

N = transformer capacity in MVA

D = number of hours in one year (8,760 hrs)

The value of A has been calculated as follows

A = [illegible] (a + b) - (c + y)

where a = gross energy generated

Appendix 6-13 (continued)

b = percentage of energy generated by large power house (public sector)

u = power house consumption (5 per cent)

y = transmission losses (10 per cent)

__Second step transmission transformer__

The demand has been estimated by the formula

$$K' = \frac{k}{(M + m)d}$$

where K' = use factor

k = increase in energy transformed in one year

M = transformer capacity of single step transformers in kVA

m = transformer capacity of second step transformers in kVA

d = number of hours in one year (8,760 hrs)

__Power house transformer__

The demand for transformer used in power house has been calculated by the formula

$$Z = \frac{L}{\cos \phi} \left(1 + \frac{U'}{100}\right)$$

where Z = transformer capacity needed in kVA

L = established generating capacity of the power house in kVA

$\cos \phi$ = power factor of the established generating capacity (0.8)

U' = power house consumption as a percentage of gross energy generation.

Appendix 6-13 (continued)

Distribution transformer

Transformer in distribution system

From the yearly increase of energy supplied to the distribution system, the proportion going to the distribution system has been calculated on the basis of past information. Then by applying $\frac{kWh}{kVA}$ ratio, transformer capacity required for distribution system has been calculated.

Transformer used by industrial consumers

From the annual increase of energy supplied to industrial consumers, the transformer capacity required has been calculated on the basis of kWh/kVA ratio obtained from the historical data.

The additional capacity in energy generation is given in Table 6-13-15.

Table 6-13-15

ADDITIONAL CAPACITY OF ENERGY GENERATION

Year	Additional capacity MW
1972	350
1977	385
1982	485

Single step transformer

The value of 'K' has been taken as 0.32. So for 10^6 kWh energy transformer needed is

$$\text{Transformer capacity in kVA} = \frac{10^6}{8,760 \times 0.32} = \frac{10^6}{2,800} = 312$$

Appendix.6-13 (continued)

The requirements on the basis of the above norm are given in Table 6-13-16.

Table 6-13-16

SINGLE STEP TRANSFORMER REQUIREMENTS

Year	Capacity increase MW	Energy transmitted a/ kWh	Transformer kVA
1972	350	350 x 0.6 x 7 200 = 210 x 7 200 = 1 512	1 512 x 312 = 470 200
1977	385	385 x 0.6 x 7 200 = 231 x 7 200 = 1 660 000	1 660 x 312 = 517 900
1982	485	485 x 0.6 x 7 200 = 291 x 7 200 = 2 095 000	2 095 x 312 = 653 700

a/ 60% of the installed capacity has been assumed as being in operation in all for 300 days in a year.

<u>Second step transformer</u>

The value of K' has been taken as 0.25. For 10^6 kWh energy generation, 63 kVA transformer will be required. The demand for the year 1972, 1977 and 1982 is given in Table 6-13-17.

Table 6-13-17

DEMAND FOR SECOND STEP TRANSFORMERS

Year	Energy in MWH	Second step transformers kVA
1972	1 512 000	95 300
1977	1 660 000	104 600
1982	2 095 000	132 000

Appendix 6-13 (continued)

Power transformer

The demand for power transformer has been estimated on the basis of the following formula

$$Z = \frac{L}{\cos \phi} \left(1 + \frac{U'}{100}\right)$$

where $\cos \phi$ = 0.8

U' = 5.0

So, Z = 1.3,125L

and L = capacity in kW

The transformer requirements for power house use are given in Table 6-13-18.

Table 6-13-18

TRANSFORMER REQUIREMENTS FOR POWER HOUSE USE

Year	Additional capacity kW	Transformer demand kVA
1972	350 000	470 000
1977	385 000	505 000
1982	485 000	637 000

Distribution transformer

The kWh/kVA ratios for the years until 1982 are taken as follows:

Teheran - 2,000
Other cities - 1,300

The distribution of energy has been taken as 50 per cent of total kWh of power generated. Of the total energy

Appendix 6-13 (continued)

distributed, 30 per cent is taken as supply for Teheran and 70 per cent for other areas. The energy supply to Teheran and other areas is given in Table 6-13-19.

Table 6-13-19

ENERGY DISTRIBUTION

Year (1)	Additional energy 10^6 kWh (2)	Distribution 50% of col.(2) (3)	Teheran 30% of col.(3) (4)	Other areas 70% of col.(3) (5)
1972	1 512	756	227	529
1977	1 660	830	249	581
1982	2 095	1 050	315	735

Demand for transformers on the basis of kWh/kVA ratio is given in Table 6-13-20.

Table 6-13-20

DEMAND FOR TRANSFORMERS FOR THE DISTRIBUTION SYSTEM

Year	Energy increase to Teheran 10^6 kWh	kWh/kVA ratio	Demand for transformer kVA	Energy increase to other areas 10^6 kWh	kWh/kVA ratio	Demand for trans-former kVA	Trans-formers total kVA
1972	227	2 000	113 500	529	1 300	407 000	520 500
1977	249	2 000	124 500	581	1 300	565 000	571 500
1982	315	2 000	157 500	735	1 300	447 000	722 500

<u>Transformer for industrial consumers</u>

About 50 per cent of the energy distributed is assumed to be supplied to industrial consumers. Out of this, 50 per

Appendix 6-13 (continued)

cent is assumed to be supplied to HTBS industrial consumers. The kWh/kVA ratio is 3,000. The demand estimates are given in Table 6-13-21.

Table 6-13-21

REQUIREMENT OF TRANSFORMERS FOR INDUSTRIAL CONSUMERS

Year	Supplied to HTBS 10^6 kWh	Ratio	Demand for transformers kVA
1972	378	3 000	126 000
1977	415	3 000	138 000
1982	515	3 000	175 000

The total demand for transformers in Iran for the years 1972, 1977 and 1982 are given in Table 6-13-22.

Table 6-13-22

AGGREGATE DEMAND FOR TRANSFORMERS

Year	Single step trans-former kVA	Second step trans-former kVA	Power trans-former kVA	Distri-bution trans-former kVA	Industrial consumer transfor-mer kVA	Trans-former total kVA
1972	470 000	95 300	470 000	520 500	126 000	1 682 000
1977	517 900	104 600	505 000	571 500	138 000	1 837 000
1982	653 700	132 000	637 000	722 500	175 000	1 837 000

Appendix 6-13 (continued)

Switchgear and control gears

Only graphical extrapolation possible

There were no imports of switchgear and control gear during the years 1962 and 1963. Due to paucity of data, analysis by time-trend and regression could not be done, and therefore, only graphical extrapolation has been attempted.

The extrapolated values indicated by the mean curve are given in Table 6-13-23.

Table 6-13-23

SWITCHGEAR AND CONTROL GEARS: FORCAST BY GRAPHICAL EXTRAPOLATION

Year	Switchgear Million Rials	Percentage of indigenous manufacture	Value of indigenous manufacture Million Rials
1972	780	20	156
1977	1 200	50	600
1982	1 650	100	1 650

Electric fans

Time-trend analysis

The time-trend analysis based on past import of fans (no production facility exists in Iran as yet) is given in Appendix 6-26. The equation established is

$$Y = 65,600 + 15,000\ t + 200t^2$$

Projections made with the help of this equation are given in Table 6-13-24.

[illegible]	Unit of output	Anticipated output	Beams	Channels	Angles	Tees
II. CONSTRUCTIONAL AND ALLIED ACTIVITIES						
A. Large and medium industries and mining ..	Mill Rials of total outlay	27 000	21 600.0	24 300.0	37 800.0	-
B. Agricultural and allied activities ..	-do-	6 000	2 407.0	4 213.0	2 106.0	150.0
C. Oil and gas ..	-do-	9 250	1 565.0	3 131.0	3 131.0	196.0
Sub-total (A to C)			25 572.0	31 644.0	43 037.0	346.0
D. Irrigation ..	-do-	13 500	12 150.0	2 050.0	3 200.0	205.0
E. Roads and bridges ..	-do-	5 300	2 640.0	422.0	1 860.0	-
F. Social services ..	-do-	23 200	186 048.0	23 256.0	8 160.0	1 163.0
G. Tele communications (posts telegraphs, telephones and radio) ..	-do-	1 330	166.0	4 940.0	2 662.0	-
H. Airports ..	-do-	1 505	83.0	50.0	210.0	-
I. Ports and harbour ..	-do-	1,800	2 500.0	898.0	6 273.0	3 947.0
Sub-total (D to I)			205 596.0	31 616.0	22 365.0	5 315.0
J. Power supply and generation						
a) Hydel ..	MW	550	4 200.0	980.0	1 170.0	21.0
b) Thermal ..	MW	60	516.0	120.0	144.0	2.0
Transmission						
a) 400 kV ..	KM	200	-	-	2 880.0	-
b) 230 kV ..	KM	450	-	-	5 922.0	-
c) 132 kV ..	KM	250	-	-	2 655.0	-
Distribution ..	Mill Rials of total outlay	1 110	-	-	4 500.0	-
Sub-total (J)			4 716.0	1 100.0	17 271.0	23.0

SECTION 1

Appendix 6-13 (continued)

Table 6-13-24

ELECTRIC FANS: FORECAST BY TIME-TREND ANALYSIS

Year	t	15 000t	$200t^2$	Y Nos
1972	7	105 000	4 800	180 400
1977	12	180 000	28 800	274 000
1982	17	255 000	57 800	378 400

Regression analysis relating to per capita income as independent variable is given in Appendix 6-27. The equation established is

$$Y = -120,689 + 11,992\ x$$

Projections derived with the help of this euqtion are given in Table 6-13-25.

Table 6-13-25

ELECTRIC FANS: FORECAST BY REGRESSION ANALYSIS

Year	x '000 Rials	11 992x	Y Nos
1972	25.7	308 194	187 505
1977	33.3	399 334	278 645
1982	41.8	501 266	380 577

Air coolers

Time-trend analysis

The time-trend analysis of past availability given in Appendix 6-28 reveals that the mean curve is best described by the equation

Appendix 6-13 (continued)

$$Y = 11{,}067 + 5{,}900t + 640t^2$$

The projections are given in Table 6-13-26.

Table 6-13-26

AIR COOLERS: FORECAST BY TIME-TREND ANALYSIS

Year	t	5,900t	$640t^2$	Y Nos
1972	7	41 300	31 500	83 867
1977	12	70 800	92 000	273 867
1982	17	100 300	184 000	295 000

Regression analysis

Regression analysis, taking per capita income as independent variable, yields the equation

$$Y = 31{,}000 + 3{,}500x + 25.8x^2$$

Details are given in Appendix 6-29. The projections obtained are given in Table 6-13-27.

Table 6-13-27

AIR COOLERS: FORECAST BY REGRESSION ANALYSIS

Year	x '000 Rials	3,500x	$25.8x^2$	Y Nos
1972	25.7	89 950	17 041	137 991
1977	33.3	116 550	28 609	176 159
1982	41.8	146 300	45 079	222 379

Appendix 6-13 (continued)

Refrigerators

Time-trend analysis

The time-trend equation established by analysing the past availability given in Appendix 6-30 is

$$Y = 30,821 + 30,000t + 3,300t^2$$

The projections obtained are given in Table 6-13-28.

Table 6-13-28

REFRIGERATORS: FORECAST BY TIME-TREND ANALYSIS

Year	t	30 000t	3 300t^2	Y
1972	7	210 000	165 000	405 821
1977	12	360 000	475 000	866 000
1982	17	510 000	950 000	1 470 000

Regression analysis

Regression analysis taking per capita income as independent variable gave such widely divergent results that they have not been found acceptable.

Water coolers

Time-trend analysis

The time-trend equation obtained from past availability given in Appendix 6-31 is

$$Y = 5,458 + 657.5t$$

The projections derived on the basis of this equation are given in Table 6-13-29.

Table 6-13-29

WATER COOLERS: FORECAST BY TIME-TREND ANALYSIS

Year	t	657.5t	Y (Nos)
1972	7	4 602	10 060
1977	12	7 890	13 348
1982	17	11 178	16 636

Appendix 6-13 (continued)

Regression analysis

Regression analysis using per capita income as independent variable shows the best fitting equation to be

$$Y = -2,482 + 509X \text{ (vide Appendix 6-32)}$$

The projections derived are given in Table 6-13-30.

Table 6-13-30

WATER COOLERS: FORECAST BY REGRESSION ANALYSIS

Year	X ('000 Rials)	509X	Y (Nos)
1972	25.7	13 081	10 599
1977	33.3	16 950	14 468
1982	41.8	21 276	18 794

Water heaters

Time-trend analysis

Time-trend analysis of the past availability given in Appendix 6-33 gives the equation

$$Y = 2[illegible],116 + 6,300t + 1,100t^2$$

The projections derived on the basis of this equation are given in Table 6-13-31.

Table 6-13-31

WATER HEATERS: FORECAST BY TIME-TREND ANALYSIS

Year	t	6 300t	1 100t²	Y (Nos)
1972	7	44 100	54 000	127 [illegible]
1977	12	75 600	1[illegible] 000	[illegible]
1982	17	107 100	317 900	[illegible]

Appendix 6-13 (continued)

Regression analysis

The regression equation fitted, taking per capita income as independent variable, is

$$Y = 5,000 + 500X + 300X^2 \text{ (vide Appendix 6-34)}$$

The projections obtained on the basis of this equation are given in Table 6-13-32.

Table 6-13-32

WATER HEATERS: FORECAST BY REGRESSION ANALYSIS

Year	X ('000 Rials)	500X	$300X^2$	Y (Nos)
1972	25.7	12 850	198 147	215 997
1977	33.3	16 650	332 667	354 317
1982	41.8	20 900	524 172	550 072

Radio receivers

Time-trend analysis

The time-trend analysis of the past availability given in Appendix 6-35 resulted in the equation

$$Y = 89,256 + 23,000t + 1,020t^2$$

The projections obtained are given in Table 6-13-33.

Table 6-13-33

RADIO RECEIVERS: FORECAST BY TIME-TREND ANALYSIS

Year	t	23 000t	$1 020t^2$	Y (Nos)
1972	7	161 000	50 000	300 256
1977	12	276 000	147 000	512 256
1982	17	391 000	295 000	775 256

Appendix 6-13 (continued)

Regression analysis

Regression analysis of the past availability with per capita income as independent variable gives the equation

$$Y = 300,000 - 17,000X + 700X^2$$

Details of the mathematical model are given in Appendix 6-36. The projections derived on the basis of the above equation are given in Table 6-13-34.

Table 6-13-34

RADIO RECEIVERS FORECAST BY REGRESSION ANALYSIS

Year	X ('000 Rials)	17 000X	$700X^2$	Y (Nos)
1972	25.7	436 900	462 343	325 443
1977	33.3	566 100	776 223	510 123
1982	41.8	710 600	1 223 068	812 468

Television sets

Time-trend analysis

The time-trend equation obtained by analysis of the past availability given in appendix 6-37 is

$$Y = 7,540 + 3,600t + 410t^2$$

The projections derived are given in Table 6-13-35.

Table 6-13-35

TELEVISION SETS FORECAST BY TIME-TREND ANALYSIS

Year	t	3 600t	$410t^2$	Y (Nos)
1972	7	25 200	20 800	53 540
1977	12	43 200	59 000	109 740
1982	17	61 200	122 000	190 740

Appendix [illegible] (continued)

Regression analysis [illegible] Regression analysis was also tried with per capita income as independent variable. The results obtained are widely divergent from time-trend analysis and field survey results. Therefore, these are not considered for comparison.

[illegible]

[illegible]

Time-trend analysis [illegible] Only time-trend analysis has been made. The time-trend equation derived from the past availability given in appendix [illegible] is

[illegible]

The values derived from equation are given in Table [illegible].

Table [illegible]

[illegible]
[illegible]

[illegible]	[illegible]	[illegible]	Million [illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Time-trend analysis [illegible] Time-trend analysis of past imports as per appendix [illegible] gives the equation

[illegible]

Appendix 6-15 (continued)

The projections derived from this equation are given in Table 6-15-37.

Table 6-15-37

INDUSTRIAL BOILERS: FORECAST BY TIME-TREND ANALYSIS

Year	X	75X	Y[a] Million Rials
1972	7	525	806.4
1977	12	900	1 181.4
1982	17	1 275	1 556.4

[a] Of the total demand, likely indigenous production for determining steel requirement is taken as zero in 1972 and 12% and 52% by 1977 and 1982 respectively.

Regression analysis

The regression equation obtained by correlating with index of industrial production is

$$Y = -124 + 3.05X \text{ (vide Appendix 6-40)}$$

and the projections obtained are given in Table 6-15-38.

Table 6-15-38

INDUSTRIAL BOILERS: FORECAST BY REGRESSION ANALYSIS

Year	X	3.05X	Y[a] Million Rials
1972	315.5	956	832
1977	551.4	1 68[illegible]	1 558
1982	930.1	2 834	2 710

[a] Of the total demand, likely indigenous production for determining steel requirements is taken as zero in 1972 and 12% and 50% by 1977 and 1982 respectively.

Appendix 6-13 (continued)

<u>Air compressors</u>

Time-trend analysis

Time-trend analysis of the past imports given in Appendix 6-41 gives the following equation for the mean curve

$$Y = 142 + 44t$$

The projections derived are given in Table 6-13-39.

Table 6-13-39

AIR COMPRESSORS: FORECAST BY TIME-TREND ANALYSIS

Year	t	44t	Y Million Rials
1972	7	308	450
1977	12	528	670
1982	17	748	890

Indigenous production capacity

The output levels adopted for calculating the steel requirement are derived from the production programme planned for Arak machine building plant, which would meet only 10%, 30% and 40% respectively of the total demand estimate for the years 1972, 1977 and 1982. Based on these targets the estimated values of indigenous production are given in Table 6-13-40.

Appendix 6-15 (continued)

Table 6-15-40

INDIGENOUS PRODUCTION OF AIR COMPRESSORS

Year	Demand Million Rials	Percentage of indigenous production	Indigenous production Million Rials
1972	450	10	45
1977	670	30	200
1982	890	40	356

D. Metal products

Steel wire ropes

Time-trend analysis

The time-trend analysis of past import data given in Appendix 6-42 yielded the equation

$$Y = 294 + 82t + 25t^2$$

Projections derived on the basis of this equation are given in Table 6-15-41.

Table 6-15-41

STEEL WIRE ROPES: FORECAST BY TIME TREND ANALYSIS

Year	t	82t	t^2	$25t^2$	Y Nos
1972	7	574	49	1 225	2 093
1977	12	984	144	3 600	4 878
1982	17	1 394	289	7 225	8 913

Regression analysis

The regression equation, taking the index of industrial production as economic indicator, is

$$Y = 1,14 + 2,3X + 0,0046X^2$$

ams	Channels	Angles	Tees	Plates	Plain sheets/strips C.rolled	Plain sheets/strips H.rolled	Coated sheets Galvanised	Coated sheets Tinned	Wires	Bars/rods	Pipes/tubes
300.0	24 300.0	37 800.0	-	21 600.0	-	18 900.0	40 500.0	-	-	4 320.0	6 480.
107.0	4 213.0	2 106.0	150.0	150.0	-	90.0	5 692.0	-	163.0	9 027.0	9 027.
565.0	3 131.0	3 131.0	196.0	783.0	-	79.0	392.0	-	-	2 475.0	432.
572.0	31 644.0	43 037.0	346.0	22 533.0	-	19 069.0	46 584.0	-	163.0	15 822.0	15 939.
150.0	2 050.0	3 200.0	205.0	14 850.0	405.0	1 050.0	4 050.0	-	-	63 700.0	-
340.0	422.0	1 860.0	-	-	-	2 112.0	6 600.0	-	-	50 880.0	-
048.0	23 256.0	8 160.0	1 163.0	-	-	5 814.0	23 256.0	-	2 326.0	60 486.0	46 512.
166.0	4 940.0	2 662.0	-	-	-	9 318.0	1 331.0	-	-	14 248.0	-
83.0	50.0	210.0	-	-	-	255.0	826.0	-	-	6 732.0	-
500.0	898.0	6 273.0	3 947.0	6 273.0	-	-	8 262.0	-	-	16 524.0	-
596.0	31 616.0	22 365.0	5 315.0	21 123.0	405.0	18 529.0	44 325.0	-	2 326.0	212 570.0	46 512.
200.0	980.0	1 170.0	21.0	395.0	-	196.0	395.0	-	-	11 200.0	1 050.
516.0	120.0	144.0	2.0	3.0	-	24.0	48.0	-	-	1 830.0	156.
-	-	2 880.0	-	160.0	-	-	-	-	-	160.0	-
-	-	5 922.0	-	329.0	-	-	-	-	-	329.0	-
-	-	2 653.0	-	147.0	-	-	-	-	-	147.5	-
-	-	4 500.0	-	250.0	-	-	-	-	-	250.0	-
716.0	1 100.0	17 271.0	23.0	1 286.5	-	220.0	443.0	-	-	13 916.5	1 206.

SECTION 2

Appendix 6-15 (continued)

Details are given in Appendix 6-43. The projections obtained with the help of this equation are given in Table 6-15-42.

Table 6-15-42

STEEL WIRE ROPE: FORECAST BY REGRESSION ANALYSIS

Year	X	2.4X	$0.0045X^2$	Y Tons
1972	515.5	721	442	1 164.14
1977	851.4	1 260	1 368	2 637.14
1982	929.1	2 157	3 865	6 025.14

Bolts, nuts and rivets

Time-trend analysis

The time-trend equation established from the past import data given in Appendix 6-44 is

$$Y = 3,803 + 775t$$

The projections based on this equation are given in Table 6-15-43.

Table 6-15-43

BOLTS, NUTS AND RIVETS: FORECAST BY TIME-TREND ANALYSIS

Year	t	775t	Y Tons
1972	7	5 425	9 [illegible]
1977	12	9 300	13 103
1982	17	13 175	16 978

Regression analysis

Regression equation formulated by correlating index of industrial production as independent variable is

Appendix 6-13 (continued)

$$Y = 1,031 + 21X$$

Details of the mathematical model are given in Appendix 6-45. The projections made on the basis of this equation are given in Table 6-13-44.

Table 6-13-44

BOLTS, NUTS AND RIVETS: FORECAST BY REGRESSION ANALYSIS

Year	X	21X	Y Tons
1972	313.3	6 579	7 610
1977	551.4	11 579	12 610
1982	929.1	19 511	20 542

Ball and roller bearings

Time-trend analysis

On the basis of availability given in Appendix 6-46 the time-trend equation fitted is

$$Y = 0.88 + 0.082t$$

The projections obtained from this equation are given in Table 6-13-45.

Table 6-13-45

BALL AND ROLLER BEARINGS - FORECAST BY TIME TREND ANALYSIS

Year	t	0.082t	Y Million Nos
1972	7	0.574	1.454
1977	12	0.984	1.874
1982	17	1.394	2.274

Appendix 6-13 (continued)

Regression analysis

The regression equation correlating index of industrial production as independent variable (Appendix 6-47) is

$$Y = 0.09 + 0.005X$$

The projections obtained are as given in Table 6-13-46.

Table 6-13-46

BALL AND ROLLER BEARINGS: FORECAST BY REGRESSION ANALYSIS

Year	X	0.005X	Y Million Rls
1972	315.7	1.587	1.667
1977	551.4	2.757	2.847
1982	929.1	4.646	4.736

Builders hardware

Time-trend analysis

Time-trend analysis of the past availability data given in Appendix 6-48 shows the appropriate equation that could be fitted is

$$Y = 1,386 + 71t + 27.5t^2$$

The projections obtained are given in Table 6-13-47.

Table 6-13-47

BUILDERS HARDWARE FORECAST BY TIME-TREND ANALYSIS

Year	t	71t	$27.5t^2$	Y Tons
1972	7	497	1 350	3 204
1977	12	852	4 000	6 208
1982	17	1 207	7 950	10 563

Appendix 6-13 (continued)

Regression analysis

The equation established by regression analysis using per capita income as the economic indicator is

$$Y = 1,480 + 200\bar{X} + 16(\bar{X})^2$$

Details are given in Appendix 6-49. The projections calculated from this equation are given in Table 6-13-48.

Table 6-13-48

BUILDERS HARDWARE: FORECAST OF OUTPUT MADE BY REGRESSION ANALYSIS

Year	X	$200\bar{X}$	$16(\bar{X})$	Y Tons
1972	25.7	2 160	1 [illegible]	5 476
1977	33.5	3 [illegible]	5 417	10 547
1982	41.8	5 340	11 578	18 408

Tanks

Time-trend analysis

The time-trend equation computed from past availability given in Appendix 6-50 is

$$Y = 6,088 + 1,240t$$

The projections derived are given in Table 6-13-49.

Table 6-13-49

TANKS: FORECAST BY TIME-TREND ANALYSIS

Year	t	$1,240t$	Y Tons
1972	7	8 680	14 768
1977	12	14 880	20 [illegible]
1982	17	21 [illegible]	27 [illegible]

Appendix 6-13 (continued)

Gas cylinders

Time-trend analysis

The time-trend equation derived on the basis of past availability given in Appendix 6-51 is

$$Y = 94,300 + 31,000t + 2,150t^2$$

The projections obtained from this equation are given in Table 6-13-50.

Table 6-13-50

GAS CYLINDERS: FORECAST BY TIME-TREND ANALYSIS

Year	t	31,000t	$2,150t^2$	Y (Nos)
1972	7	217 000	105 000	416 300
1977	12	372 000	310 000	776 300
1982	17	527 000	640 000	1 261 300

Wire nails

Time-trend analysis

The time-trend equation computed by analysis of availability given in Appendix 6-52 is

$$Y = 6,426 + 710t$$

The projections derived are given in Table 6-13-51.

Table 6-13-51

WIRE NAILS: FORECAST BY TIME-TREND ANALYSIS

Year	t	710t	Y (Tons)
1972	7	4 970	11 [illegible]
1977	12	8 520	14 946
1982	17	12 070	18 496

Appendix 6-13 (continued)

Wire netting and wire products

Time-trend analysis

The time-trend analysis of past availability given in Appendix 6-53 shows that the least square curve is represented by the equation

$$Y = 2{,}435 + 290t$$

The projections obtained are given in Table 6-13-52.

Table 6-13-52

WIRE NETTING AND WIRE PRODUCTS: FORECAST BY TIME-TREND ANALYSIS

Year	t	290t	Y Tons
1972	7	2 030	4 465
1977	12	3 480	5 915
1982	17	4 930	7 365

Stoves

Time-trend analysis

The time-trend analysis of past availability of stoves given in Appendix 6-54 gives the least square parabolic equation

$$Y = 64{,}400 + 5{,}800t + 1{,}280t^2$$

The projections derived are given in Table 6-13-53.

Appendix 6-13 (continued)

Table 6-13-53

STOVES: FORECAST BY TIME-TREND ANALYSIS

Year	t	5,800t	1,320t²	Y Nos
1972	7	40 600	65 000	170 000
1977	12	69 600	190 000	324 000
1982	17	98 600	385 000	518 000

Regression analysis

The regression equation derived on the basis of past availability and per capita income as independent variable is

$$Y = 300 + 6{,}500X + 33X^2 \text{ (vide Appendix 6-55)}$$

The projections derived are given in Table 6-13-54.

Table 6-13-54

STOVES: FORECAST BY REGRESSION ANALYSIS

Year	X	6,500X	33X²	Y Nos
1972	25.7	167 050	21 7[illegible]	1[illegible]9 146
1977	33.3	216 [illegible]	[illegible]	[illegible]
1982	41.8	271 700	57 [illegible]	[illegible]

Sewing machines

Time-trend analysis

The time-trend analysis of past import data given in Appendix 6-[illegible] shows the fitting equation to be

$$Y = [illegible],1[illegible] + [illegible]$$

The projections derived are given in Table 6-13-55.

Appendix 6-18 (continued)

Table 6-1[illegible]-AA

SEWING MACHINES: FORECAST BY TIME-TREND ANALYSIS

Year	[illegible]	[illegible]	[illegible]
[illegible]	7	[illegible]	[illegible]
1977	12	108 [illegible]	[illegible]
[illegible]	17	[illegible]	[illegible]

The regression equation obtained by correlating the past imports which represent consumption with per capita income as independent variable is

Regression analysis

$$Y = 28,000 + 8,100X$$

Details are given in Appendix 6-17. The projections obtained on the basis of this equation are given in Table 6-18-[illegible].

Table 6-18-[illegible]

SEWING MACHINES: FORECAST BY REGRESSION ANALYSIS

Year	[illegible]	[illegible]	[illegible]
[illegible]	[illegible].7	131 [illegible]	[illegible]
1977	[illegible]	[illegible]	[illegible]
[illegible]	41.[illegible]	[illegible] 180	[illegible] 180

Tin [illegible]

The equation computed by time-trend analysis of tinplate import data given in Appendix 6-[illegible] is

Time-trend analysis

$$Y = 10,[illegible] + 3,[illegible]$$

Appendix [illegible] (continued)

The projections derived are given in Table [illegible].

Table [illegible]

TIN CANS: FORECAST BY TIME-TREND ANALYSIS

Year	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

The demand for tinplate may however be reduced to some extent due to substitution by aluminium, plastics, glass etc. Taking [illegible] per cent, [illegible] per cent and [illegible] per cent respectively of the demand during the three years under study, will be reduced due to substitution, the net demand will be as given in Table [illegible].

Net demand of tinplate

Table [illegible]

NET DEMAND FOR TINPLATE ALLOWING FOR SUBSTITUTION

Year	[illegible] Tons	Net Demand Tons
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible]

Time-trend analysis

The time-trend analysis of the total consumption of [illegible] given in Appendix [illegible] shows that the trend may be expressed by the equation

Appendix G-12 (continued)

$Y = [illegible] + [illegible]$

The projections obtained on the basis of this equation are given in Table [illegible].

Table [illegible]

[illegible]

Year	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	14 [illegible]	19 [illegible]
[illegible]	[illegible]	[illegible]	[illegible] 110
[illegible]	[illegible]	[illegible]	[illegible] 160

Regression analysis

Using index of industrial production as independent variable, the simple regression equation obtained is

$Y = [illegible]$

Details are given in Appendix [illegible]. The projections derived from the equation are given in Table [illegible].

Table [illegible]

[illegible]

Year	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Appendix 6-11 (continued)

Plates	Plain sheets/strips C.rolled	Plain sheets/strips H.rolled	Coated sheets Galvanised	Coated sheets Tinned	Wires	Bars/rods	Pipes/tubes	Total
1 600.0	-	18 900.0	40 500.0	-	-	4 320.0	6 480.0	175 500.0
150.0	-	90.0	5 692.0	-	163.0	9 027.0	9 027.0	33 025.0
783.0	-	79.0	392.0	-	-	2 475.0	432.0	12 184.0
2 533.0	-	19 069.0	46 584.0	-	163.0	15 822.0	15 959.0	220 709.0
1 850.0	405.0	1 050.0	4 050.0	-	-	63 700.0	-	101 640.0
-	-	2 112.0	6 600.0	-	-	50 880.0	-	64 514.0
-	-	5 814.0	23 256.0	-	2 328.0	60 486.0	46 512.0	357 021.0
-	-	9 318.0	1 331.0	-	-	14 248.0	-	32 663.0
-	-	255.0	826.0	-	-	6 732.0	-	8 156.0
6 273.0	-	-	8 262.0	-	-	16 524.0	-	44 686.0
1 123.0	405.0	18 529.0	44 325.0	-	2 328.0	212 570.0	46 512.0	608 682.0
395.0	-	196.0	395.0	-	-	11 200.0	1 050.0	19 607.0
3.0	-	24.0	48.0	-	-	1 830.0	156.0	2 845.0
160.0	-	-	-	-	-	160.0	-	3 200.0
329.0	-	-	-	-	-	329.0	-	6 580.0
147.0	-	-	-	-	-	147.5	-	2 950.0
250.0	-	-	-	-	-	250.0	-	5 000.0
1 286.5	-	220.0	443.0	-	-	13 916.5	1 206.0	40 182.0

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Item		Unit of output	Anticipated output	Beams	Channels	Angles	Tees
II. CONSTRUCTIONAL AND ALLIED ACTIVITIES (Cont'd)							
K. Transport							
New lines, signalling and safety works	..	KM	300	90.0	90.0	170.0	10.
Track renewal	..	KM	136	-	-	-	-
Electrification	..	KM	150	2 550.0	1 200.0	929.0	19.
Maintenance (wagons only)	..	No	3 000	-	60.0	60.0	-
Sub-total (K)	..	..	..	2 640.0	1 350.0	1 159.0	59.
Total	..	..	..	239 788.9	74 094.0	113 249.0	6 181.

Item		Unit of output	Anticipated output	Rails	Fish plates
K. Transport (cont'd)					
New lines, signalling and safety works	..	KM	300	25 500.0	1 200.0
Track renewal	..	KM	136	10 680.0	272.0
Electrification	..	KM	150	-	-
Maintenance (wagons only)	..	No	3 000	-	-
Sub-total (K - cont'd)	..	..	..	36 180.0	1 472.0
Semis ..	..	..	..		..
Grand total	..	..	..		..

a/ Semis for seamless tubes.

SECTION 1

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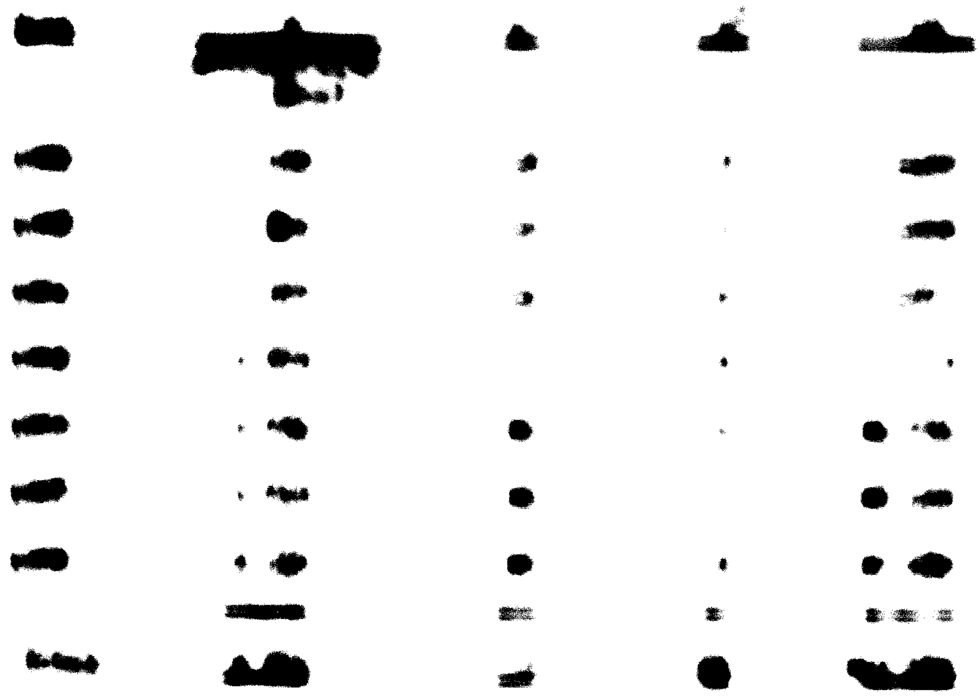

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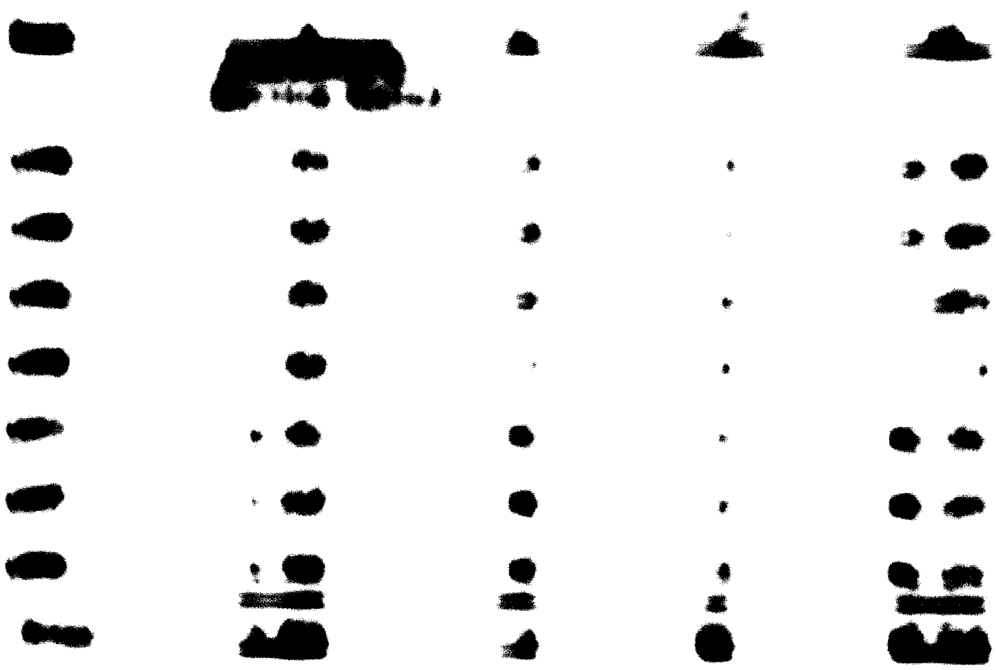

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Beams	Channels	Angles	Tees	Plates	Plain sheets/strips C.rolled	Plain sheets/strips H.rolled	Coated sheets Galvanised	Coated sheets Tinned	Wires	Bars/ rods	Pipe tubes
90.0	90.0	170.0	10.0	900.0	-	900.0	-	-	2 700.0	900.0	45
-	-	-	-	-	-	-	-	-	-	-	-
550.0	1 200.0	929.0	49.0	120.0	-	9.0	-	-	45.0	750.0	1
-	60.0	60.0	-	150.0	-	1 050.0	-	-	-	150.0	[illegible]
640.0	1 350.0	1 159.0	59.0	1 170.0	-	1 959.0	-	-	2 745.0	1 800.0	67
788.9	74 094.0	113 249.0	6 181.3	244 655.0	374,801.31	313 896.0	95 171.05	66 000.0	17 387.8	348 455.8	84 2

Rails :	Fish plates	Fish bolts	Sleepers	Dog spikes	Points and crossing
					B/F ..
25 500.0	1 200.0	300.0	21 600.0	450.0	1 050.0
10 680.0	272.0	68.0	9 810.0	-	-
-	-	-	-	-	-
-	-	-	-	-	-
36 180.0	1 472.0	368.0	31 410.0	450.0	1 050.0
	..		..		..
	..		..		..

SECTION 2

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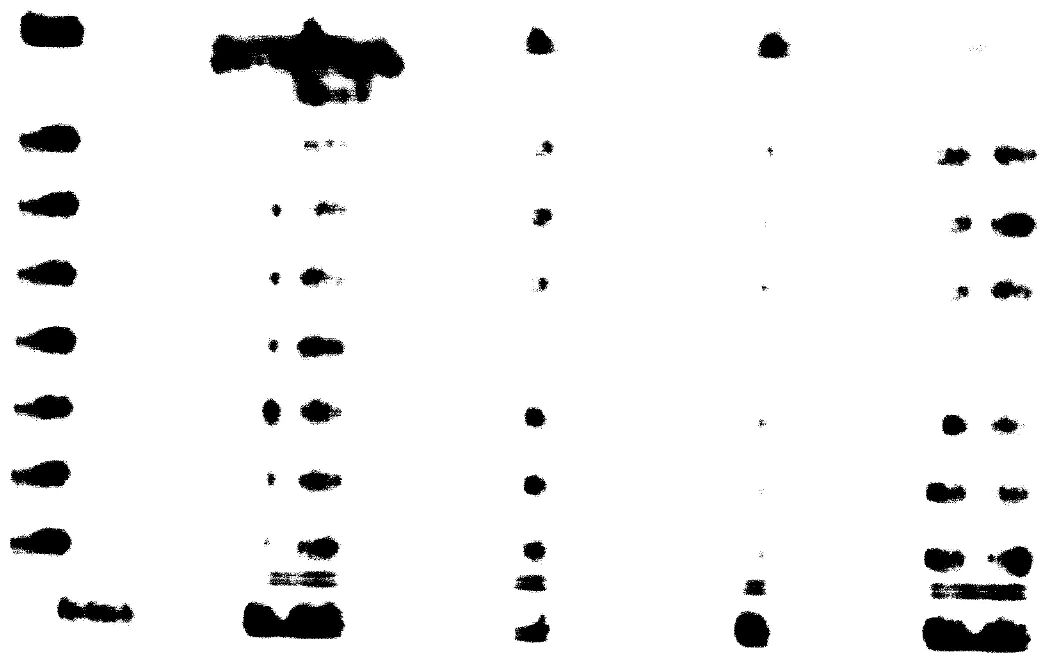

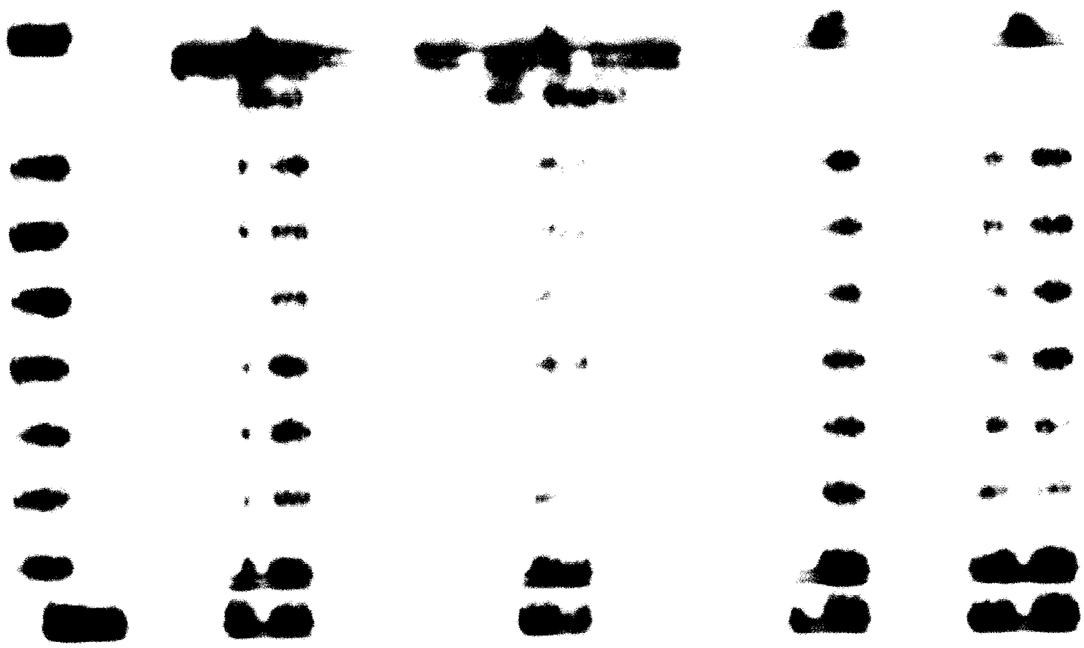

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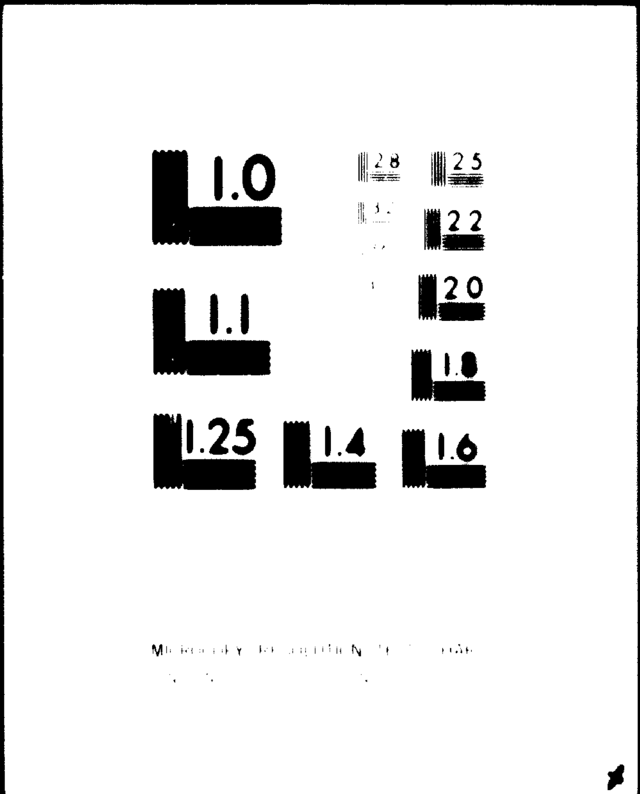

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Appendix 6-43

STEEL WIRE ROPE - REGRESSION ANALYSIS

Year	Y availability (Tons)	X Index of industrial production (Nos)	X^2	X^3	X^4	XY	X^2Y
1962	207	92	[illegible] x 10^2	77.9 x 10^4	77.9 x 10^6	[illegible] 000	25.5 x 10^5
1963	164	100	100 x 10^2	100.0 x 10^4	100.0 x 10^6	16 400	18.4 x 10^5
1964	216	114	130 x 10^2	149.0 x 10^4	169.0 x 10^6	24 600	28.0 x 10^5
1965	295	127	162 x 10^2	205.0 x 10^4	262.0 x 10^6	37 000	48.0 x 10^5
1966	411	143	205 x 10^2	[illegible] x 10^4	404.0 x 10^6	[illegible] 000	84.0 x 10^5
1967	617	170	290 x 10^2	492.0 x 10^4	[illegible] x 10^6	105 000	180.0 x 10^5
1968	716	181	[illegible] x 10^2	[illegible] x 10^4	1 2[illegible]0.0 x 10^6	137 000	255.0 x 10^5
Total	2 748	927	1 325 x 10^2	[illegible] x 10^4	3 121.0 x 10^6	[illegible]	[illegible] x 10^5

The regression equation is

$$Y = 1.14 + 2.3X + .0046X^2$$

Appendix 6-44

BOLTS, NUTS AND RIVETS - TIME-TREND ANALYSIS

Year	Y Availability (Nos)	t	t^2	t^3	t^4	tY
1962	2 821	-3	9	-27	81	-8 463
1963	2 453	-2	4	-8	16	-4 906
1964	1 971	-1	1	-1	1	-1 971
1965	2 737	0	0	0	0	0
1966	3 943	+1	1	+1	1	+3 943
1967	5 124	+2	4	+8	16	+10 248
1968	7 [illegible]	+3	9	+27	81	+22 [illegible]
Total	26 [illegible]	0	28	0	196	+21 [illegible]

The time-trend equation is

$Y = 3\ 805 + 773t$

with the base year 1965.

Appendix 6-45

BOLTS, NUTS AND RIVETS - REGRESSION ANALYSIS

Year	Y Availability (Tons)	X Index of Industrial Production (Nos)	X^2	XY
1962	2 821	92	8 464	259 532
1963	2 455	100	10 000	245 500
1964	1 971	114	12 996	224 694
1965	2 757	127	16 129	350 139
1966	3 943	143	20 449	563 849
1967	5 124	170	28 900	871 080
1968	7 552	181	32 761	1 366 912
Total	26 623	927	129 699	3 881 508

The regression equation is

$Y = 1\ 081 + 21X$

Appendix 6-46

BALL AND ROLLER BEARINGS - TIME-TREND ANALYSIS

Year	Y Availability (Million Nos)	t	t^2	tY
1962	0.78	-3	9	-2.34
1963	0.68	-2	4	-1.36
1964	0.64	-1	1	-0.64
1965	0.77	0	0	0
1966	1.00	+1	1	+1.00
1967	1.16	+2	4	+2.32
1968	1.11	+3	9	+3.33
Total	6.14	0	28	+2.31

The time-trend equation is

$$Y = 0.88 + 0.082t$$

with the base year 1965.

Appendix 6-47

BALL AND ROLLER BEARING - REGRESSION ANALYSIS

Year	Y Availability (Million Nos)	X Index of industrial production (Nos)	X^2	XY
1962	0.78	92	8 464	71.76
1963	0.68	102	10 000	68.00
1964	0.64	114	12 996	72.96
1965	0.77	127	16 129	97.79
1966	1.00	143	20 449	143.00
1967	1.16	170	28 900	197.20
1968	1.11	181	32 761	200.91
Total	6.14	927	129 699	851.62

The regression equation is

$$Y = 0.09 + 0.006X$$

Appendix 6-48

BUILDERS HARDWARE - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	t^3	t^4	tY	t^2Y
1962	1 387	-3	9	-27	81	-4 161	12 348
1963	1 210	-2	4	-8	16	-2 420	4 840
1964	1 350	-1	1	-1	1	-1 350	1 350
1965	1 454	0	0	0	0	0	0
1966	1 461	+1	1	+1	1	+1 461	1 461
1967	1 536	+2	4	+8	16	+3 072	6 144
1968	1 797	+3	9	+27	81	+5 391	16 173
Total	10 195	0	28	0	196	+1 993	42 318

The time-trend equation is

$$Y = 1\,356 + 71t + 27.5t^2$$

with the base year 1965.

Appendix 6-49

Appendix 6-49

BUILDERS HARDWARE - REGRESSION ANALYSIS

Year	Y Availability (Tons)	X Per capita income ('000 Rials)	$(\bar{X})$	$(\bar{X})^2$	$(\bar{X})^3$	$(\bar{X})^4$	$(\bar{X})Y$	$(\bar{X})^2Y$
1962	1 387	12.9	-2.0	4.00	-8.0	16.0	-2 764	5 548
1963	1 210	13.4	-1.5	2.25	-3.4	5.0	-1 720	2 740
1964	1 350	13.5	-1.4	1.96	-2.8	3.8	-1 9[illegible]	2 650
1965	1 454	14.9	0	0	0	0	0	0
1966	1 461	15.9	+1.0	1.00	+1.0	1.0	+1 461	1 461
1967	1 536	18.6	+3.7	13.8[illegible]	+51.[illegible]	19[illegible]	+5 7[illegible]	21 250
1968	1 797	2[illegible].5	+5.1	26.[illegible]	+134.[illegible]	89.[illegible]	9 2[illegible]	47 [illegible]
Total	1[illegible] 195	1[illegible]9.2	+[illegible]9	59.[illegible]	+172.8	857.8	[illegible] 977	[illegible] 648

The regression equation is

$$Y = 1\,45[illegible] + 2[illegible]X + .6(\bar{X})^2$$

Appendix 6-50

TANKS - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	tY
1962	4 500	-3	9	-13 500
1963	4 900	-2	4	-9 800
1964	1 835	-1	1	-1 835
1965	3 687	0	0	0
1966	7 383	+1	1	+7 383
1967	8 578	+2	4	+17 156
1968	11 700	+3	9	+35 100
Total	42 583	0	28	+34 504

The time-trend equation is

$$Y = 6\,083 + 1\,240t$$

with the base year 1965.

Appendix 6-51

Appendix 6-51

GAS CYLINDER - TIME-TREND ANALYSIS

Year	Y Availability (Nos)	t	t^2	t^3	t^4	tY	t^2Y
1962	22 000	-3	9	-27	81	-66 000	198 000
1963	43 000	-2	4	-8	16	-86 000	172 000
1964	55 000	-1	1	-1	1	-55 000	55 000
1965	94 000	0	0	0	0	0	0
1966	136 000	+1	1	+1	1	+136 000	136 000
1967	150 000	+2	4	+8	16	+300 000	600 000
1968	200 000	+3	9	+27	81	+600 000	1 800 000
Total	700 000	0	28	0	196	+829 000	2 961 000

The time-trend equation is

$$Y = 94\,300 + 31\,000t + 2\,150t^2$$

with base year 1965.

Appendix 6-59

WIRE NAILS - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	tY
1962	5 627	-3	9	-16 881
1963	3 960	-2	4	-7 920
1964	5 536	-1	1	-5 536
1965	5 425	0	0	0
1966	7 998	+1	1	+7 998
1967	7 114	+2	4	+14 228
1968	9 323	+3	9	+27 969
Total	44 983	0	28	+19 858

The time-trend equation is

$Y = 6\,426 + 710t$

with the base year 1965.

Appendix 6-35

RADIO RECEIVERS - TIME-TREND ANALYSIS

Year	Y Availability (Nos)	t	t^2	t^3	t^4	tY	t^2Y
1962	23 000	-3	9	-27	81	-69 000	207 000
1963	67 589	-2	4	-8	16	-135 178	270 356
1964	49 846	-1	1	-1	1	-49 846	49 846
1965	100 400	0	0	0	0	0	0
1966	109 196	+1	1	+1	1	+109 196	109 196
1967	133 176	+2	4	+8	16	+266 352	532 704
1968	170 000	+3	9	+27	81	+510 000	1 530 000
Total	[illegible]	0	28	0	196	+631 524	2 699 102

The time-trend equation is

$$Y = 89\ 236 + 23\ 000t + 1\ 0[illegible]t^2$$

with the base year 1965.

Appendix 6-53

WIRE NETTING AND WIRE PRODUCTS - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	tY
1962	1 331	-3	9	-3 993
1963	2 273	-2	4	-4 560
1964	2 224	-1	1	-2 224
1965	2 465	0	0	0
1966	2 477	+1	1	+2 477
1967	2 272	+2	4	+4 544
1968	4 002	+3	9	+12 006
Total	17 044	0	28	+8 280

The time-trend equation is

$Y = 2\ 435 + 290t$

with the base year 1965.

Appendix 6-54

Appendix 6-54

STOVES - TIME-TREND ANALYSIS

Year	Y Availability (Nos)	t	t^2	t^3	t^4	tY	t^2Y
1962	65 000	-3	9	-27	81	-195 000	585 000
1963	87 000	-2	4	-8	18	-174 000	348 000
1964	84 000	-1	1	-1	1	-84 000	84 000
1965	92 000	0	0	0	0	0	0
1966	65 000	+1	1	+1	1	65 000	65 000
1967	100 000	+2	4	+8	16	+200 000	400 000
1968	120 000	+3	9	+27	81	+360 000	1 080 000
Total	613 000	0	28	0	196	+172 000	2 562 000

The time-trend equation is

$$Y = 64\ 400 + 5\ 800t + 1\ 320t^2$$

with the base year 1965.

Appendix 6-66

STOVES - REGRESSION ANALYSIS

Year	Y Availability (Nos)	X Per capita income ('000 Rials)	X^2	X^3	X^4	XY	X^2Y
1962	65 000	12.9	165	2 140	27 200	840 000	10 800 000
1963	87 000	13.4	180	2 400	32 400	1 170 000	15 700 000
1964	89 000	13.5	184	2 480	34 000	1 140 000	15 400 000
1965	92 000	14.9	220	3 280	48 000	1 370 000	20 200 000
1966	65 000	15.9	250	4 000	64 500	1 030 000	16 300 000
1967	100 000	18.6	350	6 500	122 200	1 860 000	36 000 000
1968	120 000	20.0	400	8 000	160 000	2 400 000	48 000 000
Total	618 000	109.2	1 749	28 800	481 100	9 780 000	161 200 000

The regression equation is

$$Y = 3[illegible]0 + 6\,500X + 33X^2$$

Appendix 6-56

SEWING MACHINES - TIME-TREND ANALYSIS

Year	Y Availability (Nos)	t	t^2	tY
1962	45 000	-3	9	-135 000
1963	95 000	-2	4	-190 000
1964	94 400	-1	1	-94 000
1965	91 700	0	0	0
1966	109 000	+1	1	+109 000
1967	80 300	+2	4	+160 600
1968	160 000	+3	9	+480 000
Total	675 400	0	28	+330 200

The time-trend equation is

$$Y = 96\ 486 + 8\ 920t$$

with the base year 1965.

Appendix 6-57

SEWING MACHINE - REGRESSION ANALYSIS

Year	Y Availability (Nos)	X Per capita income ('000 Rials)	X^2	XY
1962	45 000	12.9	165	580 500
1963	95 000	13.4	180	1 273 000
1964	94 400	13.5	184	1 274 400
1965	91 700	14.9	220	1 366 330
1966	109 000	15.9	250	1 733 100
1967	80 300	18.6	350	1 493 580
1968	160 000	20.0	400	3 200 000
Total	675 400	109.2	1 749	10 920 910

The regression equation is

$$Y = 25\,000 + 5\,100X$$

Appendix 6-58

TIN CANS - TIME-TREND ANALYSIS

Year	Y Consumption (Tons)	t	t^2	tY
1962	10 339	-3	9	-31 017
1963	9 996	-2	4	-19 992
1964	14 670	-1	1	-14 670
1965	21 449	0	0	0
1966	27 401	+1	1	27 401
1967	22 530	+2	4	45 060
1968	31 392	+3	9	94 176
Total	137 776	0	28	100 958

The time-trend equation is

$$Y = 19\,682 + 3\,900t$$

with the base year 1965.

Appendix 6-59

ARC WELDING ELECTRODES - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	tY
1962	802	-3	9	-2 406
1963	574	-2	4	-1 148
1964	1 261	-1	1	-1 261
1965	4 220	0	0	0
1966	6 770	+1	1	+6 770
1967	8 752	+2	4	+17 504
1968	13 005	+3	9	+39 015
Total	35 384	0	28	+58 474

The time-trend equation is

$$Y = 5\,055 + 2\,005t$$

with the base year 1965.

Appendix 6-60

ARC WELDING ELECTRODES - REGRESSION ANALYSIS

Year	Y Availability (Tons)	X Index of industrial production (Nos)	X^2	XY
1962	802	92	8 464	73 784
1963	574	100	10 000	57 400
1964	1 261	114	12 996	143 754
1965	4 220	127	16 129	535 940
1966	6 770	143	20 449	968 110
1967	8 752	170	28 900	1 487 840
1968	13 005	181	32 761	2 353 905
Total	35 384	927	129 699	5 620 753

The regression equation is

$$Y = 3\ 683 + 82X$$

Appendix 6-61

STEEL DOORS AND WINDOWS - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	t^3	t^4	tY	t^2Y
1962	36 000	-3	9	-27	81	-108 000	32 400
1963	39 000	-2	4	-8	16	-78 000	156 000
1964	43 000	-1	1	-1	1	-43 000	43 000
1965	48 000	0	0	0	0	0	0
1966	40 000	+1	1	+1	1	+40 000	40 000
1967	54 000	+2	4	+8	16	+108 000	108 000
1968	54 000	+3	9	+27	81	+162 000	162 000
Total	314 000	0	28	0	196	+81 000	1 265 000

The time-trend equation is

$$Y = 44\ 422 + 2\ 500t + 107t^2$$

with the base year 1965.

Appendix 6-62

HEAVY PIPES AND TUBES - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	tY
1962	72 677	-3	9	-218 031
1963	60 277	-2	4	-120 554
1964	125 985	-1	1	-125 985
1965	174 172	0	0	0
1966	106 376	+1	1	+176 376
1967	283 155	+2	4	+566 310
1968	416 064	+3	9	+1 248 192
Total	1 238 704	0	28	+1 456 310

The time-trend equation is

$$Y = 176\ 943 + 46\ 000t$$

with the base year 1965.

Appendix 6-36

RADIO RECEIVERS - REGRESSION ANALYSIS

Year	Y Availability (Nos)	X Per capita income ('000 Rials)	X^2	X^3	X^4	XY	X^2Y
1962	23 000	12.9	166	2 140	27 200	300 000	3 800 000
1963	67 569	14.4	180	2 400	32 400	910 000	14 000 000
1964	49 846	13.5	184	2 480	34 000	600 000	91 200 000
1965	100 408	14.9	220	3 200	48 000	1 570 000	25 200 000
1966	109 196	15.9	250	4 000	64 500	1 740 000	27 200 000
1967	133 176	18.6	350	6 500	122 200	2 480 000	46 800 000
1968	170 000	20.0	400	8 000	212 000	3 400 000	60 000 000
Total	653 215	109.2	1 749	28 800	536 100	11 000 000	190 200 000

The regression equation is

$$Y = 300\ 000 - 17\ 000X + 700X^2$$

Appendix 6-63

RAZOR BLADES - TIME-TREND ANALYSIS

Year	Y Availability (Million Nos)	t	t^2	tY
1962	85	-3	9	-255
1963	98	-2	4	-196
1964	113	-1	1	-113
1965	106	0	0	0
1966	156	+1	1	+156
1967	278	+2	4	+556
1968	285	+3	9	+855
Total	1 121	0	28	+1 003

The time-trend equation is

$$Y = 160 + 37.5t$$

with the base year 1965.

Appendix 6-64

RAZOR BLADES - REGRESSION ANALYSIS

Year	Y Availability (Million Nos)	X Population (Million Nos)	X^2	X^3	X^4	XY	X^2Y
1962	85	23.4	5.5×10^2	13.4×10^3	30.0×10^4	2[illegible] x 10^2	46.6×10^3
1963	98	24.0	5.8×10^2	13.8×10^3	33.5×10^4	23.5×10^2	57.0×10^3
1964	113	24.7	6.2×10^2	15.4×10^3	38.5×10^4	28.[illegible] x 10^2	69.0×10^3
1965	1[illegible]6	25.[illegible]	6.4×10^2	16.2×10^3	41.[illegible] x 10^4	27.5×10^2	68.[illegible] x 10^3
1966	156	26.[illegible]	6.8×10^2	17.7×10^3	46.5×10^4	4[illegible].6 x 10^2	1[illegible]6.[illegible] x 10^3
1967	278	26.7	7.2×10^2	19.2×10^3	52.[illegible] x 10^4	7[illegible] x 10^2	2[illegible] x 10^3
1968	285	27.5	7.6×10^2	20.8×10^3	58.[illegible] x 10^4	78.5×10^2	217.[illegible] x 10^3
Total	1 121	177.6	45.5×10^2	116.5×10^3	2[illegible]9.5 x 10^4	292.1×10^2	763.8×10^3

The regression equation is

$$Y = 22 + 5.46X + 0.22X^2$$

Appendix 6-65

HACKSAW BLADES - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	tY
1962	114	-3	9	-442
1963	107	-2	4	-214
1964	127	-1	1	-127
1965	160	0	0	0
1966	142	+1	1	+142
1967	175	+2	4	+350
1968	199	+3	9	+597
Total	1 024	0	28	+306

The time-trend equation is

$$Y = 145 + 11t$$

with the base year 1965.

Appendix 6-66

HACKSAW BLADES - REGRESSION ANALYSIS

Year	Y Availability (Tons)	X Index of industrial production (Nos)	X^2	XY
1962	114	92	8 464	10 488
1963	107	100	10 000	10 700
1964	127	114	12 996	14 478
1965	160	127	16 129	20 320
1966	142	143	20 449	20 306
1967	175	170	28 900	29 750
1968	179	181	32 761	32 399
Total	1 004	927	129 699	138 441

The regression equation is

$$Y = 80 + 0.45X$$

Appendix 6-67

DOMESTIC UTENSILS - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	tY
1962	220	-3	9	-660
1963	210	-2	4	-420
1964	349	-1	1	-349
1965	410	0	0	0
1966	453	+1	1	+453
1967	709	+2	4	+1 418
1968	752	+3	9	+2 256
Total	3 103	0	28	+2 698

The time-trend equation is

$$Y = 443 + 96t$$

with the base year 1965.

Appendix 6-68

TONNAGE STEEL CONSUMPTION - TIME-TREND ANALYSIS

Year	Y Steel consumption ('000 tons)	t	tY	t^2	t^2Y	t^4
1956	336	-6	-2 016	36	12 200	1 296
1957	336	-5	-1 680	25	8 400	625
1958	464	-4	-1 856	16	7 424	256
1959	430	-3	-1 290	9	3 870	81
1960	506	-2	-1 012	4	2 024	16
1961	351	-1	-351	1	351	1
1962	347	0	0	0	0	0
1963	355	+1	+355	1	355	1
1964	504	+2	+1 008	4	1 216	16
1965	682	+3	+2 046	9	6 138	81
1966	715	+4	+2 860	16	11 440	256
1967	1 163 a/	+5	+5 815	25	29 075	625
1968	1 150 a/	+6	+6 900	36	41 400	1 296
Total	7 339	0	+10 779	182	115 893	4 550

The time-trend equation is

$$Y = 495 + 59.24t + 5.5t^2$$

with base year 1962.

a/ The direct import of tonnage steel amounted to 1,218,000 tons and 1,337,000 tons in the year 1967 and 1968 respectively. These included the import of pipes and other steel materials for IGAT project amounting to 55,000 tons in 1967 and 187,000 tons in 1968 which are seasonal or are shot demand for a project which is not likely to repeat. Consequently the consumptions have been adjusted for these two years so that trend is not vitiated by a sudden seasonal variation.

Appendix 6-69

STEEL CONSUMPTION AND NATIONAL INCOME - REGRESSION ANALYSIS

Year	Y Steel consumption (Tons)	X National income (Billion Rials)	X^2	XY	X^3	X^4	X^2Y
1960	506	289.8	8.4×10^4	14.5×10^4	8.2×10^6	70×10^8	425×10^5
1961	351	295.0	8.7×10^4	1[illegible] $\times 10^4$	8.7×10^6	74×10^8	350×10^5
1962	347	301.6	9.0×10^4	12.5×10^4	9.0×10^6	81×10^8	31[illegible] $\times 10^5$
1963	355	322.0	10.4×10^4	11.4×10^4	10.4×10^6	108×10^8	370×10^5
1964	504	334.2	11.0×10^4	16.6×10^4	11.2×10^6	121×10^8	554×10^5
1965	680	376.7	14.2×10^4	25.5×10^4	14.0×10^6	2[illegible] $\times 10^8$	970×10^5
1966	715	412.8	17.0×10^4	29.5×10^4	17.0×10^6	289×10^8	$1\ 220 \times 10^5$
1967	1 165	497.4	24.5×10^4	57.8×10^4	25.[illegible] $\times 10^6$	6[illegible] $\times 10^8$	$2\ 849 \times 10^5$
1968	1 150	550.0	30.5×10^4	63.2×10^4	[illegible] $\times 10^6$	915×10^8	$3\ 508 \times 10^5$
Total	**5 771**	**3 579.5**	**133.7×10^4**	**241.0 $\times 10^4$**	**133.3×10^6**	**$2\ 458 \times 10^8$**	**1[illegible] 556 $\times 10^5$**

The regression equation is

Y = 51[illegible] + [illegible].95X + [illegible]1X^2

Appendix 6-70

STEEL CONSUMPTION AND INDEX OF INDUSTRIAL PRODUCT - REGRESSION ANALYSIS

Year	Y Steel consumption (Tons)	X Index of industrial production (Nos)	X^2	XY
1962	347	92	82×10^2	32 000
1963	355	100	100×10^2	35 000
1964	504	114	130×10^2	57 500
1965	680	127	162×10^2	86 500
1966	715	143	205×10^2	102 000
1967	1 163	170	290×10^2	198 000
1968	1 150	181	356×10^2	208 000
Total	4 914	927	$1\,325 \times 10^2$	718 000

The regression equation is

$$Y = -52 + 5.5X$$

Appendix

ALLOY STEEL REQUIRE
(all units in

Item		Unit of output	Anticipated output	Carbon construc-tional steel
A. Transport equipment				
1.	Railway wagons ..	Nos	100	52.10
2.	Trailers ..	"	900	6.30
3.	Buses and mini-buses ..	"	9 000	90.00
4.	Cars ..	"	50 000	1 175.00
5.	Trucks ..	"	6 550	66.50
6.	Jeeps, station wagons, ambulances and vannets ..	"	14 000	420.00
7.	Motor cycles, scooters and mopeds	"	30 000	19.50
8.	Automobile ancillaries ..	Million Rials	167	93.00
9.	Vehicular diesel engines ..	Nos	10 000	70.00
9a.	Vehicular petrol engines ..	"	10 000	15.00
10.	Bicycles complete ..	"	100 000	2.00
10a.	Auto leaf springs (maintenance) a/	Tons	4 000	-
	Sub-total A ..			2 009.40
B. Electrical equipment				
11.	Electric transformers ..	1000 KVA	1 000	-
12.	Electric motors ..	1000 KW	30	6.00
13.	Switchgear and control gear ..	Million Rials	200	1.60
15.	House service meter ..	1000 Nos	50	-
16.	Electric fans ..	1000 Nos	165	1.70
18.	Refrigerators (domestic and commercial) ..	1000 Nos	300	-
21.	Radio receivers ..	1000 Nos	340	0.34
23.	P.A. system ..	Million Rials	-	-
24.	Electric and electronic equipment	Million Rials	-	-
25.	Airconditioners ..	1000 Nos	5	3.75
	Sub-total B ..			13.39
C. Industrial and agricultural machinery				
26.	Weighing machinery ..	Million Rials	75	0.75
27.	Tea pressing machinery ..	"	50	-
28.	Agricultural tractors ..	Nos	2 500	-
29.	Agricultural implements ..	Tons	3 500	192.50

SECTION 1

Appendix 6-71

ALLOY STEEL REQUIREMENT - 1972
(all units in tons)

…put	Anticipated output	Carbon constructional steel	Free cutting steel	Spring steel	Alloy constructional steel	Stainless steel	Electric steel she…
	100	52.10	-	140.00	-	-	-
	900	6.30	-	22.50	25.50	-	-
	9 000	90.00	90.00	1 890.00	-	-	-
	50 000	1 175.00	425.00	2 175.00	2 875.00	-	-
	6 550	66.50	66.50	1 325.50	687.75	-	-
	14 000	420.00	140.00	840.00	1 470.00	-	-
	30 000	19.50	49.00	29.00	234.00	-	-
…ials	187	93.00	28.00	28.00	38.00	3.00	-
	10 000	70.00	50.00	-	250.00	-	-
	10 000	15.00	15.00	15.00	73.00	-	-
	100 000	2.00	-	-	-	-	-
	4 000	-	-	4 400.00	-	-	-
		2 009.40	863.50	10 865.00	6 600.25	3.00	
…A	1 000	-	-	-	-	-	3 324.0…
	30	6.00	6.00	-	-	-	213.0…
…ials	200	1.60	4.40	3.00	30.00	-	60.0…
…s	50	-	-	-	-	-	20.0…
…s	165	1.70	-	-	1.70	-	-
…s	300	-	-	207.50	-	1 575.00	-
…s	340	0.34	-	0.68	-	6.80	-
…ials	-	-	-	-	-	-	-
…ials	-	-	-	-	-	-	-
…s	5	3.75	1.25	0.50	3.75	1.25	-
		13.39	11.65	211.68	35.45	1 583.05	3 617.…
…ials	75	0.75	1.90	-	1.50	-	-
	50	-	-	-	12.25	2.10	-
	2 500	-	150.00	12.50	337.50	-	-
	3 500	192.50	70.00	87.50	105.00	-	-

SECTION 2

Appendix 6-37

TELEVISION SETS - TIME-TREND ANALYSIS

Year	Y Availability (Nos)	t	t^2	t^3	t^4	tY	t^2Y
1962	2 000	-3	9	-27	81	-6 000	18 000
1963	2 360	-2	4	-8	16	-4 720	9 440
1964	3 982	-1	1	-1	1	-3 982	3 982
1965	7 706	0	0	0	0	0	0
1966	9 418	+1	1	+1	1	+9 418	9 418
1967	12 827	+2	4	+8	16	+25 654	51 308
1968	21 980	+3	9	+27	81	+65 940	197 820
Total	[illegible]	0	28	0	196	[illegible]	[illegible]

The time-trend equation is

$$Y = 7\ 848 + 3\ 600t + 410t^2$$

with the base year 1965.

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...ing	Spring steel	Alloy construc-tional steel	Stainless steel	Electrical steel sheets	Total
	140.00	-	-	-	192.10
	22.50	25.50	-	-	54.30
0	1 890.00	-	-	-	3 015.00
0	2 175.00	2 875.00	-	-	6 650.00
0	1 325.50	687.75	-	-	2 146.25
0	840.00	1 470.00	-	-	2 870.00
0	29.00	234.00	-	-	331.50
	28.00	38.00	3.00	-	190.00
	-	250.00	-	-	370.00
	15.00	73.00	-	-	120.00
	-	-	-	-	2.00
	4 400.00	-	-	-	4 100.00
0	10 865.00	6 600.25	3.00		20 341.15
	-	-	-	3 324.00	3 324.00
0	-	-	-	213.00	225.00
0	3.00	30.00	-	60.00	99.00
	-	-	-	20.00	20.00
	-	1.70	-	-	3.40
	207.50	-	1 575.00	-	1 782.50
	0.66	-	6.80	-	7.82
	-	-	-	-	-
	-	-	-	-	-
5	0.50	3.75	1.25	-	10.80
5	211.66	35.45	1 583.05	3 617.00	5 472.22
0	-	1.90	-	-	4.15
	-	12.25	2.10	-	14.35
0	12.50	237.50	-	-	300.00
0	87.50	106.00	-	-	486.00

SECTION 3

Item		Unit of output	Anticipated output	Carbon constructional steel
C. Industrial and agricultural machinery (cont'd)				
30. Crawler tractors	..	Nos	-	-
31. Building and road construction machinery	..	Million Rials	-	-
32. Stationary diesel engines	..	Nos	1 000	30.00
33. Cranes	..	Tons	500	25.00
34. Passenger and industrial lifts	..	Nos	250	-
35. Fork lifts	..	"	-	-
36. Other material handling equipment		Million Rials	-	-
37. Industrial boilers	..	"	-	-
38. Air compressors	..	"	50	0.35
39. Power driven pumps	..	Nos	20 000	-
40. Textile machinery	..	Million Rials	100	8.00
41. Sugar machinery	..	"	150	-
42. Cement machinery	..	"	162	3.50
43. Equipment for chemical industry	..	Tons	15 000	-
44. Heavy plate and vessels works	..	"	2 000	-
45. Machine tools	..	Million Rials	100	0.15
46. Machine tool accessories	..	"	3	1.50
47. Hand tools	..	Tons	2 000	-
48. Dumpers, scrapers 49. Shovels and excavators	..	Nos	200	35.00
50. Road rollers	..	"	125	-
51. Diary machinery	..	Million Rials	-	-
Sub-total C	..			296.75
D. Metal products				
52. Steel furniture	..	Tons	12 900	594.00
53. Bolts, nuts and rivets 2/	..	"	8 000	240.00
59. Wire nails	..	"	11 000	7.70
60. Wire netting and wire products	..	"	900	-
62. Sewing machines	..	'000 Nos	-	-
62a. Sewing machine needles	..	Tons	-	-
63. Typewriters and office machines	..	'000 Nos	-	-
70. Umbrella ribs	..	Million Nos	-	-
71. Razor blades 3/	..	"	330	-
72. Hacksaw blades 4/	..	'000 Nos	780	-
73. Utensils	..	Tons	883	-
74. Ball and roller bearings	..	Million Nos	5	-
Sub-total D	..			841.70
Total (A+B+C+D)	..			2 161.24

1/ The requirement of spring as original equipment is included in the respective norms.
2/ Only high tensile and special bolts have been considered.
3/ In addition to 72.6 tons of stainless steel 387 tons of high carbon steel will be required.
4/ 156 tons of tool steel will be required for hacksaw blades.

SECTION 1

…tput	Anticipated output	Carbon constructional steel	Free cutting steel	Spring steel	Alloy constructional steel	Stainless steel	Ele… steel
	-	-	-	-	-	-	-
…ials	-	-	-	-	-	-	-
	1 000	30.00	-	1.00	7.00	1.00	-
	900	38.00	13.00	0.00	100.00	-	-
	250	-	-	6.75	16.75	-	-
	-	-	-	-	-	-	-
…ials	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	90	0.25	3.00	0.25	1.50	0.08	-
	90 000	-	10.50	-	10.50	40.00	-
…ials	100	0.00	12.50	1.00	9.00	3.00	-
	150	-	30.00	0.00	17.00	3.50	-
	100	3.50	-	6.50	10.00	9.00	-
	15 000	-	-	-	1 075.00	1 [illegible].00	-
	2 000	-	-	-	-	900.00	-
…ials	100	0.15	6.50	0.15	14.00	0.90	-
	3	1.50	1.50	0.00	3.00	0.15	-
	2 000	-	-	-	900.00	-	-
	900	38.00	10.00	18.00	1 130.00	-	-
	185	-	69.50	6.50	31.50	-	-
…ials	-	-	-	-	-	-	-
		394.75	371.30	148.00	3 394.40	9 940.70	
	13 900	304.00	-	-	-	-	-
	8 000	940.00	380.00	-	400.00	179.00	-
	11 000	7.70	-	-	-	-	-
	900	-	-	-	-	3.00	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
…s	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	300	-	-	-	-	70.00	-
	700	-	-	-	-	-	
	800	-	-	-	-	-	
…s	5	-	-	-	[illegible]	-	
		941.70	380.00		4,[illegible]	190.90	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

…luded in the respective norms.
…red.
…f high carbon steel will be required.
…ides.

SECTION 2

Free cutting steel	Spring steel	Alloy construc-tional steel	Stainless steel	Electrical steel sheets	Total
-	-	-	-	-	-
-	-	-	-	-	-
-	1.00	7.00	1.00	-	30.00
13.00	8.00	100.00	-	-	146.00
-	6.95	16.75	-	-	26.00
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
5.00	0.25	1.25	0.05	-	7.00
10.20	-	10.90	48.00	-	69.00
12.00	1.80	9.40	3.00	-	34.40
20.00	0.80	17.00	3.20	-	40.00
-	6.50	40.00	9.00	-	61.00
-	-	1 005.00	1 995.00	-	3 000.00
-	-	-	800.00	-	800.00
6.00	0.15	16.00	0.70	-	23.00
1.00	0.06	3.00	0.15	-	5.01
-	-	900.00	-	-	900.00
10.00	18.00	1 100.00	-	-	1 160.00
69.00	6.25	21.75	-	-	100.00
-	-	-	-	-	-
371.30	146.04	3 304.40	1 968.70		6 384.81
-	-	-	-	-	904.00
180.00	-	400.00	177.00	-	1 048.00
-	-	-	-	-	7.70
-	-	-	3.60	-	3.60
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	75.00	-	75.00
-	-	-	-	-	-
-	-	-	-	-	-
-	-	4 100.00	-	-	4 100.00
180.00		4,500.00	190.00		5 019.90
1,[illegible]	11,[illegible]	14,[illegible]	1,[illegible]	1,017.00	30,[illegible]

SECTION 3

ALLOY S
(a

	Item	Unit of output	Anticipated output	Carbon constructional steel	Free s
A. Transport equipment					
1.	Railway wagons	No.	800	915.00	
2.	Trailers	"	4 000	28.80	
3.	Buses and mini-buses	"	25 000	250.00	
4.	Cars	"	93 000	2 200.00	
5.	Trucks	"	12 500	125.00	
6.	Jeeps, station wagons, ambulances and vanetts ..	"	28 000	840.00	
7.	Motor cycles, scooters and mopeds	"	55 000	37.10	
8.	Automobile ancillaries ..	Million Rials	1 265	63.00	
9.	Vehicular and diesel engines ..	Nos	13 500	94.50	
9a	Vehicular petrol engines ..	"	93 000	140.00	
10.	Bicycles complete ..	'000 Nos	150 000	3.00	
10a	Auto leaf springs (maintenance)$	Tons	5 400	-	
	Sub-total A	..	..	4 696.40	1
B. Electrical equipment					
11.	Electric transformers ..	'000 Nos	1 600	-	
12	Electric motors	'000 kW	150	30.00	
13	Switch and control gear ..	Million Rials	625	4.80	
15	House service meters	Nos	80 000	-	
16	Electric fans	'000 Nos	250	2.50	
17a	Air conditioners	"	35	26.00	
18.	Refrigerators (domestic & commercial)	"	600	-	
21.	Radio receivers	"	544	0.55	
22.	P.A. system	Million Rials	720	-	
24.	Electric and electronic equipment (relays, switches etc) ..	"	0.72	-	
	Sub-total B	..	..	63.85	
C. Industrial and agricultural machinery					
26.	Weighing machinery	Million Rials	165	1.60	
27.	Tea pressing machinery ..	"	90	-	
28.	Agricultural tractors ..	Nos	5 000	300.00	
29.	Agricultural implements ..	Tons	7 500	407.50	
30.	Crawler tractors	-	-	-	
31.	Building and road const m/cy ..	Million Rials	50	12.50	
32.	Stationary diesel engine ..	Nos	7 500	225.00	
33.	Cranes	Tons	2 000	10.00	
34.	Passenger and industrial lifts ..	Nos	400	-	

SECTION 1

Appendix 6-72

ALLOY STEEL REQUIREMENT 1977
(all units in tons)

nput	Anticipated output	Carbon construc-tional steel	Free cutting steel	Spring steel	Alloy construc-tional steel	Stainless steel	Elect steel
	800	915.00	-	1 120.00	-	-	-
	4 000	28.80	-	100.00	113.60	-	..
	25 000	250.00	250.00	5 250.00	2 625.00	-	-
	93 000	2 200.00	790.00	4 050.00	5 350.00	-	-
	12 500	125.00	125.00	2 625.00	1 312.50	-	-
	28 000	840.00	280.00	1 680.00	2 940.00	-	
	55 000	37.10	88.00	53.60	429.00	-	
ls	1 265	63.00	190.00	190.00	250.00	1.80	-
	13 500	94.50	67.50	-	337.50	13.50	-
	93 000	140.00	140.00	140.00	700.00	.	-
s	150 000	3.00	-	-	-	.	
	5 400	-	-	5 940.00	-	-	
	..	4 696.40	1 950.50	21 148.60	14 057.60	15.30	
s	1 600	-	-	-	-	-	5 3
V	150	30.00	30.00	-	-	-	1 06
als	625	4.80	13.80	9.40	9.40	-	19
	80 000	-	-	-	-	-	3
s	250	2.50	-	-	2.50	-	-
	35	26.00	8.50	3.50	26.00	8.50	-
	600	-	-	406.00	-	3 057.00	-
	544	0.55	-	1.00	-	10.50	-
als	720	-	-	0.02	-	0.02	-
	0.72	-	0.006	0.075	-	-	-
	..	65.85	52.306	419.[illegible]	[illegible]	3.076.02	6.6
als	165	1.60	4.10	-	3.30	-	-
	90	-	-	-	22.00	4.20	-
	5 000	300.00	-	25.00	675.00	-	-
	7 500	407.50	150.00	182.50	225.00	-	-
	-	-	-	-	-	-	-
als	50	12.50	6.00	4.00	12.50	0.50	-
	7 500	225.00	-	7.50	52.50	7.50	-
	2 000	10.00	5.00	3.00	410.00	-	-
	400	-	-	10.00	30.00	-	

SECTION 2

Appendix C-72

ALLOY STEEL REQUIREMENT 1977
(all units in tons)

...nstruc- ...steel	Free cutting steel	Spring steel	Alloy construc- tional steel	Stainless steel	Electrical steel sheets	Total
5.00	-	1 120.00	-	-	-	2 035.00
.80	-	100.00	115.60	-	-	242.40
0.00	250.00	5 250.00	2 625.00	-	-	8 375.00
0.00	790.00	4 050.00	5 350.00	-	-	12 390.00
.00	125.00	2 625.00	1 312.50	-	-	4 187.50
0.00	280.00	1 680.00	2 940.00	-	-	5 740.00
.10	88.00	55.60	429.00	-	-	607.70
.00	190.00	190.00	250.00	1.80	-	694.80
1.50	67.50	-	337.50	13.50	-	515.00
.00	140.00	140.00	700.00	-	-	1 120.00
.00	-	-	-	-	-	3.00
-	-	5 940.00	-	-	-	5 940.00
.40	1 930.50	21 148.60	14 057.60	15.30		41 840.70
-	-	-	-	-	5 328.00	5 328.00
0.00	30.00	-	-	-	1 065.50	1 125.50
4.80	13.80	9.40	9.40	-	190.00	227.40
	-	-	-	-	32.00	32.00
2.50	-	-	2.50	-	-	5.00
6.00	8.[illegible]	3.50	26.00	8.50	-	72.50
	-	406.00	-	3 057.00	-	3 465.00
0.55	-	1.00	-	10.50	-	12.05
	-	0.02	-	0.02	-	0.04
	0.006	0.075	-	-	-	0.081
3.85	52.506	419.[illegible]	[illegible]	3 076.02	6 615.50	10 265.571
1.60	4.10	-	3.30	-	-	9.00
-	-	-	22.00	4.20	-	26.20
00.00	-	25.00	675.00	-	-	1 000.00
07.50	150.00	182.50	225.00	-	-	965.00
-	-	-	-	-	-	-
2.50	6.00	4.00	12.50	0.50	-	35.50
5.00	-	7.50	52.50	7.50	-	292.50
0.00	5.00	3.00	410.00	-	-	428.00
-	-	10.00	30.00	-	-	40.00

SECTION 3

Item	Unit of output	Anticipated output	Carbon construc-tional steel	Wrought steel
C. Industrial & agricultural machinery (cont'd)				
35. Fork lifts	-	-	-	-
36. Other material handling equipment (conveying machinery etc) ..	Million Rials	100.00	5.00	-
37. Industrial boilers ..	"	160.00	-	-
38. Air compressors	"	200.00	1.70	24.
39. Power driven pumps (turbine and centrifugal)	Nos	50 000.00	-	25.
40. Textile machinery ..	Million Rials	3 000.00	240.00	400.
41. Sugar machinery	"	300.00	-	340.
42. Cement machinery	"	325.00	50.00	-
43. Equipment for chemical industry	Tons	32 000.00	-	-
44. Heavy plate and vessels ..	Tons	3 300.00	-	-
45. Machine tools	Million Rials	350.00	0.50	22.
46. Machine tool accessories ..	"	10.00	5.00	4.
47. Hand tools	Tons	3 000.00	-	-
48. Dumpers and scrapes 49. Shovels and excavators ..	Nos	425.00	5.50	1.
50. Road rollers	"	250.00	-	135.0
51. Dairy machinery	Million Rials	25.00	-	-
Sub-total C	..	..	1 264.30	1 117.
D. Metal products				
52. Steel furniture	Tons	27 000.00	1 162.00	-
53. Bolts, nuts and rivets b/ ..	"	10 000.00	285.00	332.0
60. Wire netting and wire products ..	"	1 300.00	-	-
62. Sewing machines	'000 Nos	100.00	-	2.0
62a. Sewing machine needles ..	Tons	1.25	1.50	-
63. Typewriters and office machines	Nos	-	-	-
69. Ball and roller bearings ..	Million Nos	2.00	-	-
70. Umbrella ribs	'000 Nos	250.00	3.50	-
71. Razor blades c/	Million Nos	450.00	-	-
72. Hacksaw blades d/	'000 Nos	1 110.00	-	-
73. Utensils	Tons	1 546.00	-	-
74. Ball & roller bearings ..	Million Nos	10.00	-	-
Sub-total D	..	..	1 452.00	334.
Total (A + B + C + D) ..	..	..	7 476.55	3 434.2

a/ The spring requirement as original equipment is included in the respective norm
b/ High tensile bolts and special bolts are considered
c/ 391.5 tons of high carbon tool steel is required in addition to 99 tons of stainless steel
d/ 222 tons of tool steel will be required.

SECTION 1

Appendix 6-72 (continued)

Carbon constructional steel	Free cutting steel	Spring steel	Alloy constructional steel	Stainless steel	Electrical steel sheets	Total
-	-	-	-	-	-	-
5.00	-	-	28.00	2.00	-	35.00
-	-	4.00	160.00	2.50	-	166.50
1.70	24.00	1.70	6.00	0.20	-	33.60
-	25.00	-	25.00	100.00	-	150.00
240.00	400.00	48.00	288.00	96.00	-	1 072.00
-	340.00	8.50	205.00	34.00	-	587.50
50.00	-	100.00	750.00	25.00	-	925.00
-	-	-	2 140.00	4 280.00	-	6 420.00
-	-	-	-	330.00	-	330.00
0.50	22.75	5.25	56.00	0.70	-	85.20
5.00	4.00	0.20	10.00	0.50	-	19.70
-	-	-	750.00	-	-	750.00
5.00	1.60	2.40	2 491.00	-	-	2 500.00
-	135.00	13.50	62.50	-	-	211.00
-	-	-	-	12.00	-	12.00
1 264.30	1 117.45	415.55	8 401.80	4 895.10	-	16 094.20
1 162.00	-	-	-	-	-	1 162.00
285.00	352.00	-	475.00	147.00	-	1 259.00
-	-	-	-	5.20	-	5.20
-	2.00	-	-	-	-	2.00
1.50	-	-	-	-	-	1.50
-	-	-	-	-	-	-
-	-	-	1 640.00	-	-	1 640.00
3.50	-	-	-	-	-	3.50
-	-	-	-	99.00	-	99.00
-	-	-	-	-	-	-
-	-	-	8 200.00	-	-	8 200.00
-	-	-	-	-	-	-
1 452.00	354.00	-	10 315.00	461.20	-	12 562.20
7 476.55	3 434.256	21 984.145	32 814.60	8 447.62	6 613.50	80 760.671

respective norm

99 tons of stainless steel

SECTION 2

Appendix 6-72 (continued)

Spring steel	Alloy constructional steel	Stainless steel	Electrical steel sheets	Total
-	-	-	-	-
-	28.00	2.00	-	35.00
4.00	160.00	2.50	-	166.50
1.70	6.00	0.20	-	35.60
-	25.00	100.00	-	150.00
48.00	288.00	96.00	-	1 072.00
8.50	205.00	34.00	-	587.50
100.00	750.00	25.00	-	925.00
-	2 140.00	4 280.00	-	6 420.00
-	-	330.00	-	330.00
5.25	56.00	0.70	-	85.20
0.20	10.00	0.50	-	19.70
-	750.00	-	-	750.00
2.40	2 491.00	-	-	2 500.00
15.50	62.50	-	-	211.00
-	-	12.00	-	12.00
415.55	8 401.80	4 895.10	-	16 094.20
-	-	-	-	1 162.00
-	475.00	147.00	-	1 259.00
-	-	5.20	-	5.20
-	-	-	-	2.00
-	-	-	-	1.50
-	-	-	-	-
-	1 640.00	-	-	1 640.00
-	-	-	-	3.50
-	-	99.00	-	99.00
-	-	-	-	-
-	8 200.00	-	-	8 200.00
-	-	-	-	-
-	10 315.00	461.20		12 562.20
21 984.145	32 814.60	8 447.62	6 613.30	80 780.671

SECTION 3

Appendix 6-38

OTHER MATERIAL HANDLING EQUIPMENT - TIME-TREND ANALYSIS

Year	Y Availability (million Rials)	t	t^2	tY
1962	77.6	-3	9	-232.8
1963	36.7	-2	4	-73.4
1964	110.8	-1	1	-110.8
1965	82.9	0	0	0
1966	230.6	+1	1	+230.6
1967	633.8	+2	4	+1 267.6
1968	474.1	+3	9	+1 422.1
Total	1 [illegible].5	0	28	+2 [illegible]

The time-trend equation is

$Y = 232.6 + 90t$

with the base year 1965.

ALLOY STEEL REQUIREMENT -
(all units in tons)

	Item		Unit of output	Anticipated output	Carbon const. steel	Fre... ing...
A. Transport equipment						
1.	Railway wagons	..	Nos	1 000.00	521.30	
2.	Trailers	..	"	8 000.00	57.60	
3.	Buses and mini-buses	..	"	45 000.00	450.00	
4.	Cars	..	"	162 000.00	3 813.00	1
5.	Trucks	..	"	22 000.00	220.00	
6.	Jeeps, station wagons, ambulances and vannets	..	"	50 000.00	1 500.00	
7.	Motor cycles, scooters, mopeds	..	"	88 000.00	57.20	
8.	Automobile ancillaries	..	Million Rials	1 917.00	100.00	
9.	Vehicular diesel engines	..	Nos	24 000.00	168.00	
9a.	Vehicular petrol engines a/	..	"	162 000.00	196.00	
10.	Bicycles complete	..	"	300 000.00	6.00	
10a.	Auto leaf springs (maintenance)	..	Tons	7 000.00	-	
	Sub-total A	..			7 089.10	3
B. Electrical equipment						
11.	Electrical transformers	..	1 000 kVA	2 [illegible]0.00	50.00	
12.	Electric motors	..	1 000 kW	250.00	320.00	
13.	Switchgear and control gear	..	Million Rials	1 680.00	23.00	
15.	House service meters	..	'000 Nos	125.00	-	
16.	Electric fans	..	'000 Nos	3[illegible].00	3.80	
17a.	Air conditioners	..	'000 Nos	120.00	190.00	
18.	Refrigerators (domestic and commercial)		'000 Nos	1 062.00	-	
21.	Radio receivers	..	'000 Nos	790.00	0.80	
23.	P.A. system	..	Million Rials	60.00	-	
24.	Electronic equipment	..	Million Rials	2.50	-	
	Sub-total B	..			257.60	
C. Industrial and agricultural machinery						
26.	Weighing machinery	..	Million Rials	231.00	2.30	
27.	Tea processing machinery	..	"	140.00	-	
28.	Agricultural tractors	..	Nos	10 000.00	-	
29.	Agricultural implements	..	Ton	12 000.00	660.00	
30.	Crawler tractors	..	Nos	50.00	-	
31.	Building and road construction machinery		Million Rials	150.00	37.50	
32.	Stationary diesel engines	..	Nos	25 000.00	750.00	
33.	Cranes	..	Tons	3 000.00	150.00	
34.	Passenger and industrial lifts	..	Nos	700.00	-	
35.	Fork lifts	..	"	100.00	4.00	
36.	Other material handling equipment	..	Million Rials	150.00	7.50	
37.	Industrial boilers	..	"	500.00	-	
38.	Air compressors	..	"	360.00	3.40	

SECTION 1

Appendix 6-73

Appendix 6-73

ALLOY STEEL REQUIREMENT - 1982
(all units in tons)

..icipated output	Carbon const. steel	Free cutting steel	Spring steel	Alloy const. steel	Stainless steel	Electrical steel sheets	Total
000.00	521.30	-	1 400.00	-	-	-	1 921.30
000.00	57.60	-	200.00	227.20	-	-	484.80
000.00	450.00	450.00	9 450.00	4 725.00	-	-	15 075.00
000.00	3 813.00	1 376.00	7 073.00	9 348.00	-	-	21 612.00
000.00	220.00	220.00	4 620.00	2 310.00	-	-	7 370.00
000.00	1 500.00	500.00	3 000.00	2 250.00	-	-	10 250.00
000.00	57.20	143.00	86.00	686.00	-	-	972.20
917.00	100.00	290.00	290.00	385.00	29.00	-	1 094.00
000.00	168.00	120.00	-	600.00	-	-	888.00
000.00	196.00	196.00	196.00	990.00	-	-	1 578.00
000.00	6.00	-	-	-	-	-	6.00
000.00	-	-	7 700.00	-	-	-	7 700.00
	7 089.10	3 297.00	34 015.00	24 521.20	29.00		68 951.30
560.00	50.00	-	-	-	-	6 720.00	6 720.00
250.00	320.00	320.00	-	-	1 772.50	2 000.00	1 872.50
650.00	23.00	36.80	[illegible]	25.00	-	500.00	599.80
125.00	-	-	-	-	-	50.00	50.00
375.00	3.80	-	-	3.80	-	-	7.60
120.00	190.00	30.00	12.00	90.00	30.00	-	352.00
062.00	-	-	693.00	-	3 465.00	-	4 158.00
790.00	0.80	-	1.60	-	16.00	-	18.40
60.00	-	-	0.15	-	1.15	-	1.30
1.50	-	0.012	0.15	-	-	-	0.162
	257.60	116.812	731.90	118.80	5 512.15	9 042.50	15 779.762
231.00	2.30	5.80	4.60	-	-	-	12.70
140.00	-	-	-	34.00	6.00	-	40.00
000.00	-	600.00	50.00	1 350.00	-	-	2 000.00
000.00	660.00	240.00	300.00	360.00	-	-	1 560.00
50.00	-	6.00	10.00	262.50	0.50	-	279.00
150.00	37.50	18.00	12.00	37.50	1.50	-	106.50
000.00	750.00	-	25.00	175.00	25.00	-	975.00
000.00	150.00	75.00	45.00	600.00	-	-	870.00
700.00	-	-	18.75	56.25	-	-	75.00
100.00	4.00	-	1.00	15.00	-	-	20.00
150.00	7.50	-	-	42.00	3.00	-	52.50
500.00	-	-	0.12	490.00	8.00	-	498.12
350.00	3.40	49.00	3.40	12.75	0.50	-	68.55

SECTION 2

Item		Unit of output	Anticipated output	Carbon const. steel	Fr… ing…
C. Industrial and agricultural machinery (cont'd)					
39. Power driven pumps	..	Nos	75 000.00	-	
40. Textile machinery	..	Million Rials	4 500.00	360.00	
41. Sugar machinery	..	"	480.00	-	
42. Cement machinery	..	"	520.00	10.80	
43. Equipment for chemical industries	..	"	50 000.00	-	
44. Heavy plates and vessels works	..	Tons	4 600.00	-	
45. Machine tools	..	Million Rials	450.00	0.675	
46. Machine tool accessories	..	"	15.00	7.50	
47. Hand tools	..	Tons	4 500.00	-	
48. Dumpers, scrapers 49. Shovels and excavators	..	Nos	640.00	111.00	
50. Road rollers	..	Nos	400.00	-	
51. Dairy machinery	..	Million Rials	50.00	-	
Sub-total C	..			2 104.675	1
D. Metal products					
52. Steel furniture	..	'000 tons	47.50	2 138.00	
55. Bolts, nuts and rivets b/	..	Tons	12 500.00	410.00	4
60. Wire melting and wire products	..	"	6 629.00	-	
62. Sewing machines	..	'000 Nos	150.00	-	
62a. Sewing machine needles	..	Tons	1.87	1.87	
63. Typewriters and office machines	..	'000 Nos	40.00	4.80	
69. Ball and roller bearings	..	Million Nos	15.00	-	
70. Umbrella ribs	..	Nos	300 000.00	3.75	
71. Razor blades c/	..	Million Nos	660.00	-	
72. Hacksaw blades d/	..	'000 Nos	1 380.00	-	
73. Utensils	..	Tons	2 717.00	-	
Sub-total D	..			2 558.42	
Grand Total (A+B+C+D)	..			12 009.795	5 …

a/ High tensile and special bolts are considered.
b/ Only high tensile bolts are considered.
c/ In addition to stainless steel, 574 tons of tool steel will be required.
d/ Only tool steel of 264 tons will be required.

SECTION 1

... const. steel	Free cutting steel	Spring steel	Alloy const. steel	Stainless steel	Electrical steel sheets	Total
-	37.80	-	3.75	150.00	-	191.55
0.00	576.00	72.00	480.00	144.00	-	1 304.00
-	96.00	2.40	56.00	9.60	-	164.00
.80	-	21.00	3 250.00	6 880.00	-	193.00
-	-	-	712.60	1 425.20	-	2 137.00
-	-	-	-	460.00	-	460.00
.675	29.25	675.00	73.00	0.90	-	777.825
.50	6.00	0.30	15.00	0.75	-	29.550
-	-	-	1 095.00	-	-	1 095.00
1.00	32.00	46.00	3 490.00	-	-	3 609.00
	200.00	20.00	100.00	-	-	320.00
-	-	-	-	24.00	-	24.00
.675	1 970.56	1 308.57	12 144.55	7 468.96		25 026.996
.00	-	-	-	-	-	2 120.00
.00	475.00	-	680.00	265.00	-	1 770.00
	-	-	-	27.00	-	27.00
-	3.00	0.75	-	-	-	3.75
.87	1.87	-	-	-	-	1.87
.80	-	20.00	48.00	-	-	72.80
-	-	-	12 200.00	-	-	12 200.00
.75	-	-	-	-	-	3.75
	-	-	-	146.20	-	146.20
	-	-	-	-	-	-
-	-	-	-	220.00	-	220.00
.48	475.00	20.75	13 028.00	947.20		17 028.87
.725	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SECTION 2

Appendix 6-7

ALLOY STEEL - TIME-TREND ANALYSIS

Year	Y Consumption (Tons)	t	t^2	tY
1962	7 590	-3	9	-22 770
1963	7 770	-2	4	-15 540
1964	11 860	-1	1	-11 860
1965	15 780	0	0	0
1966	18 370	+1	1	+18 370
1967	21 200	+2	4	+42 400
1968	[illegible]	+3	9	[illegible]
Total	[illegible]	0	28	[illegible]

The time-trend equation is

Y = [illegible]

with the base year 1965.

Appendix 6-7[illegible]

ALLOY STEEL - REGRESSION ANALYSIS

Year	Y Consumption (Tons)	X National Income (Billion Rials)	X^2	XY
1962	7 [illegible]	[illegible]01.6	90 [illegible]	[illegible] [illegible] 144
1963	7 770	3[illegible]7.0	10[illegible] [illegible]	[illegible] [illegible]01 [illegible]40
1964	11 [illegible]	[illegible]4.2	11[illegible] [illegible]	[illegible] [illegible]70 [illegible]
1965	1[illegible] 7[illegible]0	[illegible].7	1[illegible]1 [illegible]	[illegible] [illegible] [illegible]
1966	1[illegible] [illegible]70	[illegible].0	170 [illegible]	[illegible] [illegible] 1[illegible]
1967	[illegible]1 [illegible]	[illegible]	[illegible] 107	10 [illegible] [illegible]
1968	[illegible]	[illegible]	[illegible]	1[illegible] 077 [illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]

The regression equation is

Y = [illegible] + [illegible]X

[illegible] | [illegible]

[illegible]

[illegible]

[illegible]	[illegible] ([illegible])	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

02093
(4 of 4)

REPORT

to

THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

on

ASSESSMENT OF STEEL DEMAND IN IRAN

for

THE MINISTRY OF ECONOMY, IMPERIAL GOVERNMENT OF IRAN

VOLUME IV

DECEMBER 1970

M. N. DASTUR & COMPANY PRIVATE LTD. CALCUTTA
DASTUR ENGINEERING INTERNATIONAL GmbH, DUSSELDORF
Consulting Engineers

LIST OF VOLUMES

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Appendix 6-29

INDUSTRIAL BOILERS - TIME-TREND ANALYSIS

Year	Y Availability (Million Rials)	t	t^2	tY
1962	115.4	-3	9	-346.2
1963	100.4	-2	4	-200.8
1964	91.4	-1	1	-91.4
1965	127.6	0	0	0
1966	685.3	+1	1	+685.3
1967	506.1	+2	4	+1 012.2
1968	343.5	+3	9	+1 030.5
Total	1 969.7	0	28	+2 089.6

The time-trend equation is

$$Y = 281.4 + 75t$$

with the base year 1965.

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TABLES IN VOLUME IV

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EXPLANATION OF SYMBOLS

Three dots (...) indicate that data are not available or are not separately reported.

A dash (–) indicates that the amount is nil or negligible.

A blank space ( ) in a table means that the item is not applicable.

A plus sign (+) indicates a surplus or an increase.

A minus sign (–) indicates a deficit or decrease.

A space between numerals is used to distinguish thousands and millions (1 000 000).

A full stop (.) is used to indicate decimals.

A stroke (/) indicates a crop year or fiscal year, e.g. [illegible]

Use of a hyphen (-) between dates representing years, e.g. [illegible] normally signifies an annual average for the calendar years involved, including the beginning and end years. 'To' between the years indicates the full period, e.g. [illegible] to [illegible] means [illegible] to [illegible], inclusive.

Reference to 'tons' indicates metric tons, and to 'dollars' United States dollars, unless otherwise stated.

Details and percentages in tables do not necessarily add up to totals, because of rounding.

[illegible] | [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

7 - Export possibilities and substitution (cont'd)

[illegible] steel export prospects

Past imports of Pakistan and Turkey

Imports of steel by Pakistan and Turkey from 19[illegible] to 19[illegible] are given in Appendix 7-1 and summarized in Table 7-1.

Table 7-1

SUMMARY OF IMPORTS BY PAKISTAN AND TURKEY

Year	Pakistan tons	Turkey tons	Total tons
[illegible]	[illegible]	[illegible]	729 700
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	1 [illegible]
[illegible]	[illegible]	[illegible] 797	1 178 307
[illegible]	[illegible]	[illegible] 000	1 043 000
[illegible]	[illegible]	[illegible] 000	[illegible] 800

Though Iranian steel industry will be primarily geared to meet the [illegible] domestic demand, it may be possible to develop a modest export market particularly in the two [illegible] partner countries. The total imports of steel by Pakistan and Turkey are of the order of one million tons up to 19[illegible].

Turkey's ingot steel production from its two integrated steel plants, Karabuk and Eregli Steel Works, amounted to [illegible] tons in 19[illegible]. Together with the output of secondary producers, the total production was

Appendix 6-10

INDUSTRIAL BOILERS - REGRESSION ANALYSIS

Year	Y Availability (Million Rials)	X Index of industrial production (Nos)	X^2	XY
1962	115.4	92	8 464	10 616.8
1963	100.4	100	10 000	10 040.0
1964	91.4	114	12 996	10 419.6
1965	127.6	127	16 129	16 205.2
1966	685.3	143	20 449	97 997.9
1967	506.1	170	28 900	86 037.0
1968	[illegible]	181	32 761	[illegible]
Total	[illegible]	927	[illegible]	[illegible]

The regression equation is

Y = -124 + 3.0[illegible]X

[illegible]

[illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] (cont'd)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

7 - Import possibilities and substitution (cont'd)

Estimated consumption

The estimated steel consumption of Pakistan is at present about [illegible] tons per annum, although imports in 1967 was [illegible] tons only, due to foreign exchange difficulties. It is estimated that by [illegible] the total steel demand of Pakistan will be about [illegible] million tons, corresponding to the [illegible] per cent growth rate observed in the consumption trend. Indigenous production envisaged is of the order of [illegible] million tons. Thus, there is likely to be a gap of about [illegible] million tons to be filled in by imports.

[illegible]

[illegible]

[illegible]

7 - Export possibilities and substitution (cont'd)

annually. Broken down categorywise on the basis of Pakistan's current import trends, exports that may be visualised for the future from Iran are given in Table 7.6.

Table 7.6

POSSIBLE EXPORT [illegible] TO PAKISTAN BY [illegible]
(All figures in thousand tons)

[illegible]		[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
Total	..	[illegible]

[illegible]

[illegible]

[illegible]

7 - [illegible] (cont'd)

[illegible]

[illegible]

[illegible]

[illegible]

7 - Import possibilities and substitution (cont'd)

preference. Currently there have been many examples where iron/steel products are being replaced by aluminium and plastics.

A recent study carried out by the Economic Commission of Europe (ECE) on some aspects of competition between steel and other materials, gives the figures of substitution actually achieved in steel consuming [illegible] [illegible] in advanced countries (Table Two).

Table Two

[illegible]

[illegible]

7 - Export possibilities and substitution (cont'd)

The results of the [illegible] study, however, [illegible]

[illegible]

[illegible]

[illegible] (cont'd)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] (cont'd)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] (cont'd)

[illegible]

[illegible]

[illegible] per cent [illegible]

[illegible]

[illegible]		[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]
[illegible]	..	[illegible]

[illegible]

[illegible]

Appendix 6-41

AIR COMPRESSORS - TIME-TREND ANALYSIS

Year	Y Import (Million Rials)	t	t^2	tY
1962	20.8	-3	9	-62.4
1963	39.3	-2	4	-78.6
1964	68.5	-1	1	-68.5
1965	131.9	0	0	0
1966	131.8	+1	1	+131.8
1967	281.6	+2	4	+563.2
1968	[illegible]	+3	9	+913.[illegible]
Total	[illegible]	0	28	+1,2[illegible]

The time-trend equation is

$Y = 142 + 44t$

with the base year 1965.

V - Export possibilities and substitution (cont'd)

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
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SECTION 1

SECTION 2

Appendix 6-42

STEEL WIRE ROPE - TIME-TREND ANALYSIS

Year	Y Availability (Tons)	t	t^2	t^3	t^4	tY	t^2Y
1962	307	-3	9	-27	81	-921	2 763
1963	184	-2	4	-8	16	-368	736
1964	216	-1	1	-1	1	-216	216
1965	296	0	0	0	0	0	0
1966	411	+1	1	+1	1	+411	411
1967	617	+2	4	+8	16	+1 234	2 468
1968	718	+3	9	+27	81	+2 154	6 462
Total	2 749	0	28	0	196	+2 294	13 056

The time-trend equation is

$$Y = 294 + 82t + 25t^2$$

with the base year 1965.

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[illegible]	[illegible]	[illegible]	[illegible]
Total pig iron	[illegible]	[illegible]	[illegible]

a/ Iron requirement is calculated on the basis of:
- Metallic charge to liquid metal - [illegible] yield
- Liquid metal to castings - [illegible] yield
- Rejects and machining loss - [illegible]
- Metallic charge - 10% steel scrap - 13% rejected iron castings and machine turnings - 77% iron

[illegible]

[illegible]

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This is particularly true of all [illegible] countries [illegible] of steel consumption. Even in respect of tubes and fittings, there is considerable variation from country to country. As a recent UN study[1] has concluded, there is

[1] World trade in steel and steel demand in developing countries - U.N. Publication, New York, [illegible].

[illegible]

a/ Long term trends and problems of the European steel industry. E.C.E., Geneva, 1959.

[illegible] Iron and Steel consumption in Latin America, A study of iron and steel industry in Latin America, Vol I, New York 1954.

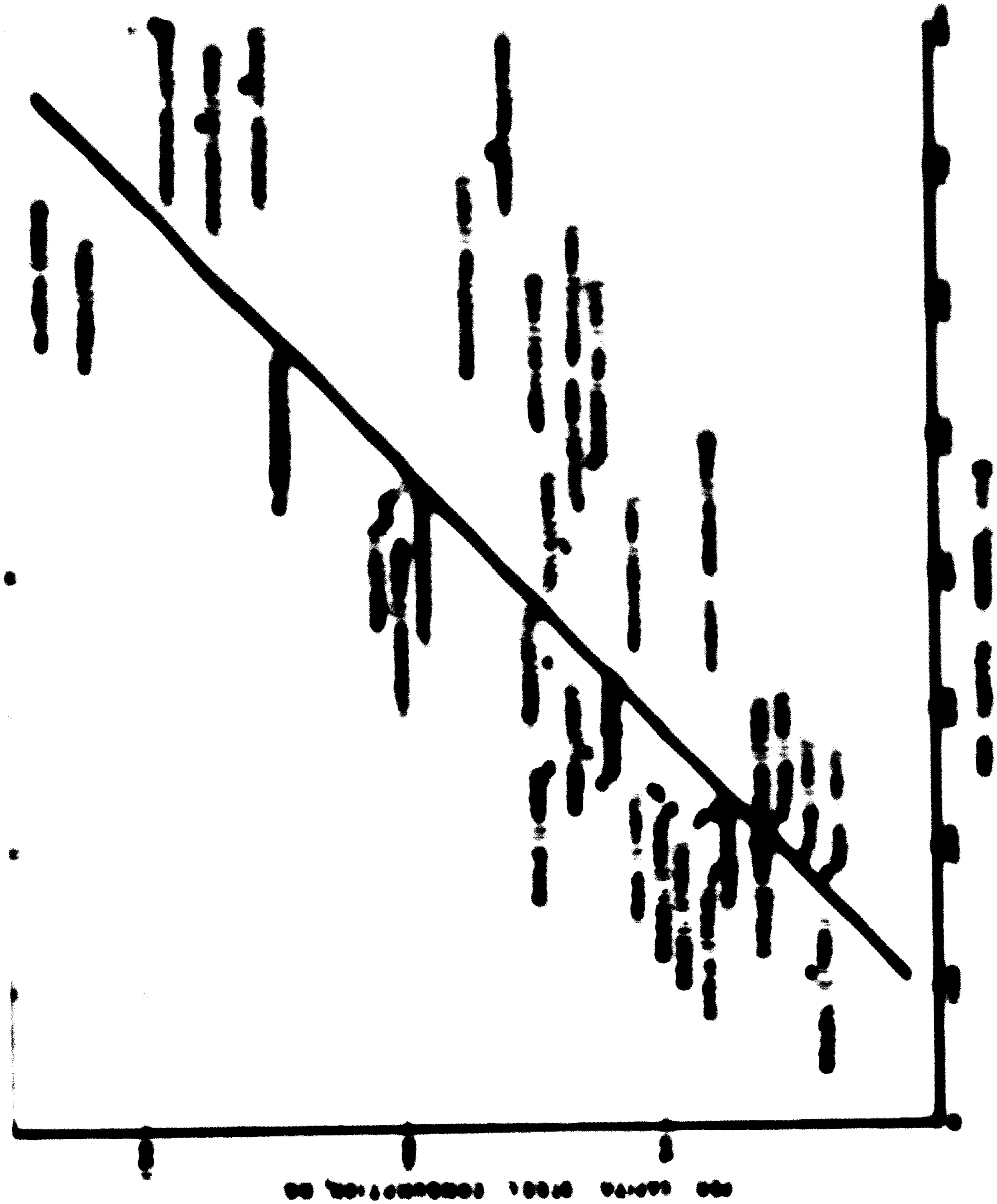

FIG. 8-1: PER CAPITA STEEL CONSUMPTION VS PER CAPITA INCOME FOR VARIOUS COUNTRIES

a/ Projection

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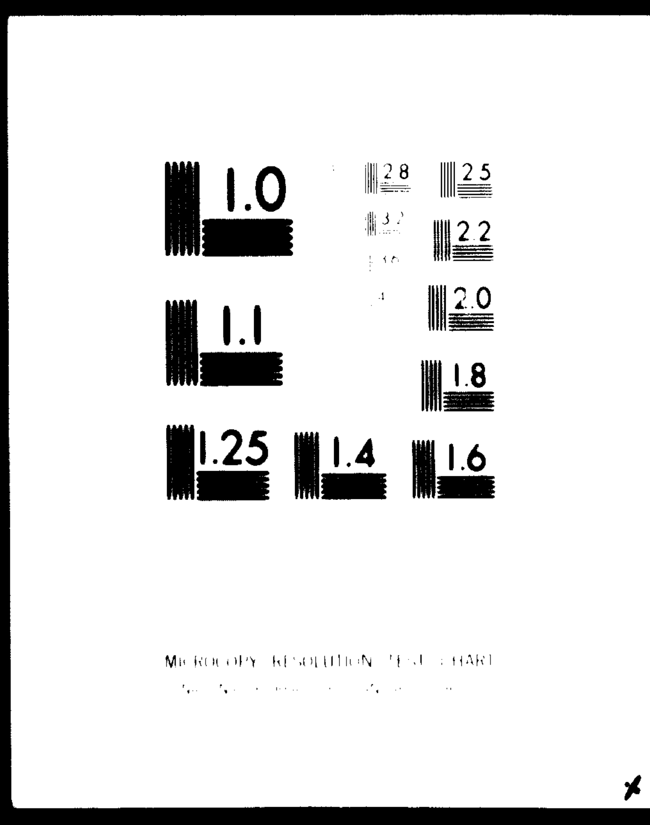

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9 - Analysis of shortfall (cont'd)

Beams Probable demand, availability and shortfalls for beams are given in Table 9-2.

Table 9-2

BEAMS: DEMAND, AVAILABILITY AND SHORTFALLS
(in thousand tons)

		Table	1972	1977	1982
Availability					
Primary producers			-	234.00	234.00
Secondary producers			-	-	-
Total availability		8-1	-	234.00	234.00
Demand	..	6-10	252.61	257.95	210.38
Export	..	7-3	-	-	4.00a/
Substitution	..	7-6	-	-	-
Total demand			252.61	257.95	214.38
Shortfall			252.61	23.95	+19.62b/

a/ Out of a total of 8,500 tons of structurals envisaged for export to Pakistan, 4,000 tons are taken as beams.

b/ + denotes surplus.

It will be noted that there would be shortfalls of 252,610 tons and 23,950 tons by 1972 and 1977 respectively and a surplus of 19,620 tons by 1982, assuming that the production programme of Isfahan steel plant is not changed.

Channels Probable demand, availability and shortfalls for channels are given in Table 9-3.

9 - Analysis of shortfall (cont'd)

Table 9-3

CHANNELS: DEMAND, AVAILABILITY AND SHORTFALLS
(in thousand tons)

Availability	Table	1972	1977	1982
Primary producers		-	11.00	11.00
Secondary producers		-	-	-
Total availability	8-1	-	11.00	11.00
Demand ..	6-10	55.96	82.27	117.54
Export ..	7-3	-	-	2.00 a/
Substitution ..	7-6	-	-	-
Total demand		55.96	82.27	119.54
Shortfall		55.96	71.27	108.54 a/

a/ Out of a total of 8,500 tons of structurals envisaged for export to Pakistan, 2,000 tons are taken as channels.

There will be substantial shortfalls in all the years under study.

Angles Probable demand, availability and shortfalls for angles are given in Table 9-4.

9 - Analysis of shortfall (cont'd)

Table 9-4

ANGLES: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

Availability		Table	1972	1977	1982
Primary producers			-	35.00	35.00
Secondary producers			20.00	20.00	20.00
Total availability		8-1	20.00	55.00	55.00
Demand	..	6-10	79.04	127.25	238.21
Export	..	7-3	-	-	2.50 a/
Substitution	..	7-6	-	-	(-3.16)
Total demand			79.04	127.25	238.55
Shortfall			59.04	72.25	182.55

a/ Out of a total of 8,500 tons of structurals envisaged for export to Pakistan, 2,500 tons are assumed to be angles.

There will be substantial shortfalls in all the years under study.

Probable demand, availability and shortfalls for tees

Tees are given in Table 9-5.

9 - Analysis of shortfall (cont'd)

Table 9-5

TEES: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

	Table	1972	1977	1982
Availability				
Primary producers		-	-	-
Secondary producers		5.00	5.00	5.00
Total availability	8-1	5.00	5.00	5.00
Demand ..	6-10	4.03	6.78	13.13
Export ..	7-3a/	-	-	-
Substitution ..	7-6	-	-	(-0.05
Total demand		4.03	6.78	13.08
Shortfall		+0.97b/	1.78	8.08

a/ Out of a total of 8,500 tons structural steel envisaged to be exported to Pakistan, tees are assumed to form a negligible proportion.

b/ + denotes surplus.

Though initially there is a small surplus of 970 tons in 1972, there will be shortfalls of 1,780 tons and 8,080 tons in 1977 and 1982 respectively.

Shortfalls of structurals are shown in Fig. 9-1. In 1982, beams will be surplus if Isfahan steel plant continues to produce beams at the rate of 234,000 tons

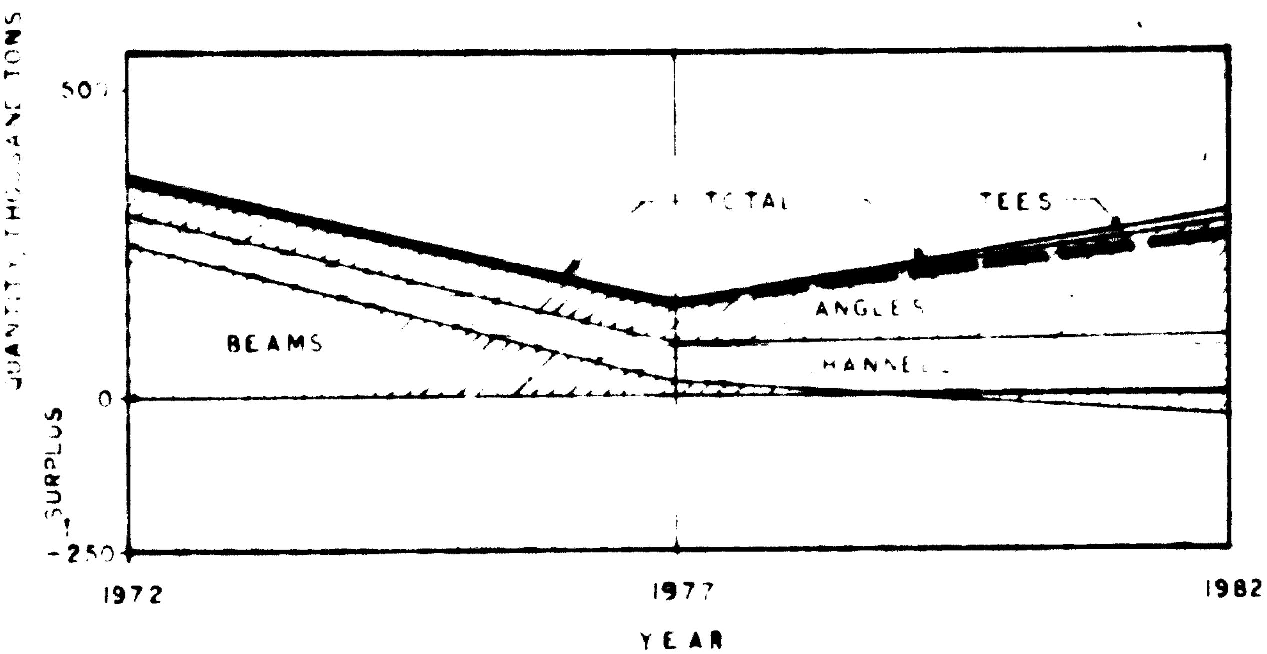


FIG 9-1 SHORTFALLS OF STRUCTURALS

9 - Analysis of shortfall (cont'd)

per year. The surplus is shown in the figure below zero level shortfall, as surplus is negative shortfall. The total shortfall curve is shown in dotted line beyond 1977 as the surplus of beams is to be subtracted from the shortfalls of channels, angles and tees taken together.

Plates

Probable demand, availability and shortfalls for plates are given in Table 9-6. The shortfalls of plates will amount to 171,970 tons, 282,900 tons and 496,590 tons in the years 1972, 1977 and 1982 respectively.

Table 9-6

PLATES: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

Availability	Table	1972	1977	1982
Primary producers		-	-	-
Secondary producers		-	-	-
Total availability	8-1	-	-	-
Demand ..	6-10	171.97	282.90	495.85
Export ..	7-3	-	-	6.00
Substituion ..	7-6	-	-	(-5.26)
Total demand		171.97	282.90	496.59
Shortfall		171.97	282.90	496.59

9 - Analysis of shortfall (cont'd)

Cold rolled sheets/strips

Probable demand, availability and shortfalls for cold rolled sheets and strips are given in Table 9-7.

Table 9-7

COLD ROLLED SHEETS AND STRIPS: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

Availability	Table	1972	1977	1982
Primary producers		-	-	-
Secondary producers		-	-	-
Total availability	8-1	-	-	-
Demand ..	6-10	225.99	451.22	831.88
Tonnage required for current indigenous production of galvanised sheets		15.00	15.00	15.00
Export ..	7-3	-	-	12.20 a/
Substituion ..	7-6	-	-	(-2.45) b/
Total demand		240.99	466.22	856.63
Shortfall		240.99	466.22	856.63

a/ Out of 30,500 tons envisaged to be exported to Pakistan, 40% has been assumed as cold rolled sheets and strips.

b/ Out of 5,650 tons of sheets/strips, 2,450 tons have been assumed to be of cold rolled sheets and strips.

9 - Analysis of shortfall (cont'd)

Coated flat products

Though galvanised sheets and tinplate can be produced from hot rolled sheets, the base material has to be taken as cold rolled sheets as it is envisaged that all future strip production will be from continuous hot strip mill which cannot normally produce strip less than 1.5 mm thick, while for galvanised sheets and tinplates, strip thinner than 1.5 mm is generally required.

Tinplate

Demand for tinplate has been estimated at 54,193 tons, 66,852 tons and 82,790 tons in 1972, 1977 and 1982 respectively (Table 6-10). As there is no indigenous production and no concrete proposal as yet for the production of tinplate, the entire demand represents the shortfall.

Galvanised sheets

In case of galvanised sheets, total demand has been estimated at 59,006 tons, 96,516 tons and 155,665 tons in the years 1972, 1977 and 1982 respectively (Table 6-10). Present indigenous production of galvanised sheets from imported base material is 15,000 tons. In the absence of specific information regarding any further expansion of capacity for the production of galvanised sheets, the total demand less 15,000 tons, namely, 44,006 tons, 81,516 tons and 140,665 tons are the shortfalls in the years 1972, 1977 and 1982 respectively.

9 - Analysis of shortfall (cont'd)

However, for estimating the shortfall for cold rolled sheets, the total demand for galvanised sheets has to be considered, as the present production of galvanised sheets is based on imported material.

Aggregate shortfalls

Adding the requirements of cold rolled sheets and strips for galvanised sheet and tinplate to the shortfall of cold rolled sheets and strips as such, the total shortfalls of cold rolled sheets and strips will amount to 339,189 tons, 614,588 tons and 1,095,085 tons by 1972, 1977 and 1982 respectively.

Proposed cold strip mill

There is a proposal to set up a cold strip mill in collaboration with a Japanese firm for the production of cold rolled sheets and strips. The envisaged annual capacity of the proposed cold rolling mill is 330,000 tons. If this materialises and the plant is in full production by 1977, the shortfalls of cold rolled sheets/strips will be about 284,588 tons by 1977 and 765,085 tons by 1982.

Hot rolled sheets/strips

Probable demand, availability and shortfall for hot rolled sheets and strips are given in Table 9-8. The shortfall is of the order of 690,000 tons in 1982.

9 - Analysis of shortfall (cont'd)

Table 9-8

HOT ROLLED SHEETS & STRIPS: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

Availability	Table	1972	1977	1982
Primary producers		-	5.00	5.00
Secondary producers		100.00	200.00	200.00
Total availability	8-1	100.00	205.00	205.00
Demand ..	6-10	232.38	365.08	687.78
Demand for sheets and strips as semis for pipes and tubes required for manufactured items a/		63.70	114.40	192.00
Export ..	7-3	-	-	18.30 b/
Substitution ..	7-6	-	-	(-3.65) c/
Total demand		296.08	479.48	894.43
Shortfall		196.08	274.48	689.43

a/ Demands of semis for the production of welded pipes and tubes constituting a part of the manufactured items are discussed later on in this chapter under pipes and tubes.

b/ Out of 30,500 tons of sheets and strips envisaged to be exported to Pakistan, 60% has been taken as hot rolled sheets.

c/ Out of 5,650 tons of sheets and strips envisaged to be substituted by 1982, 3,650 tons have been assumed as hot rolled sheets/strips.

Shortfalls of flat products are shown in Fig. 9-2. The shortfalls of plates and hot rolled sheets and strips take into consideration the demand of plates, hot rolled sheets and strips for pipes and tubes.

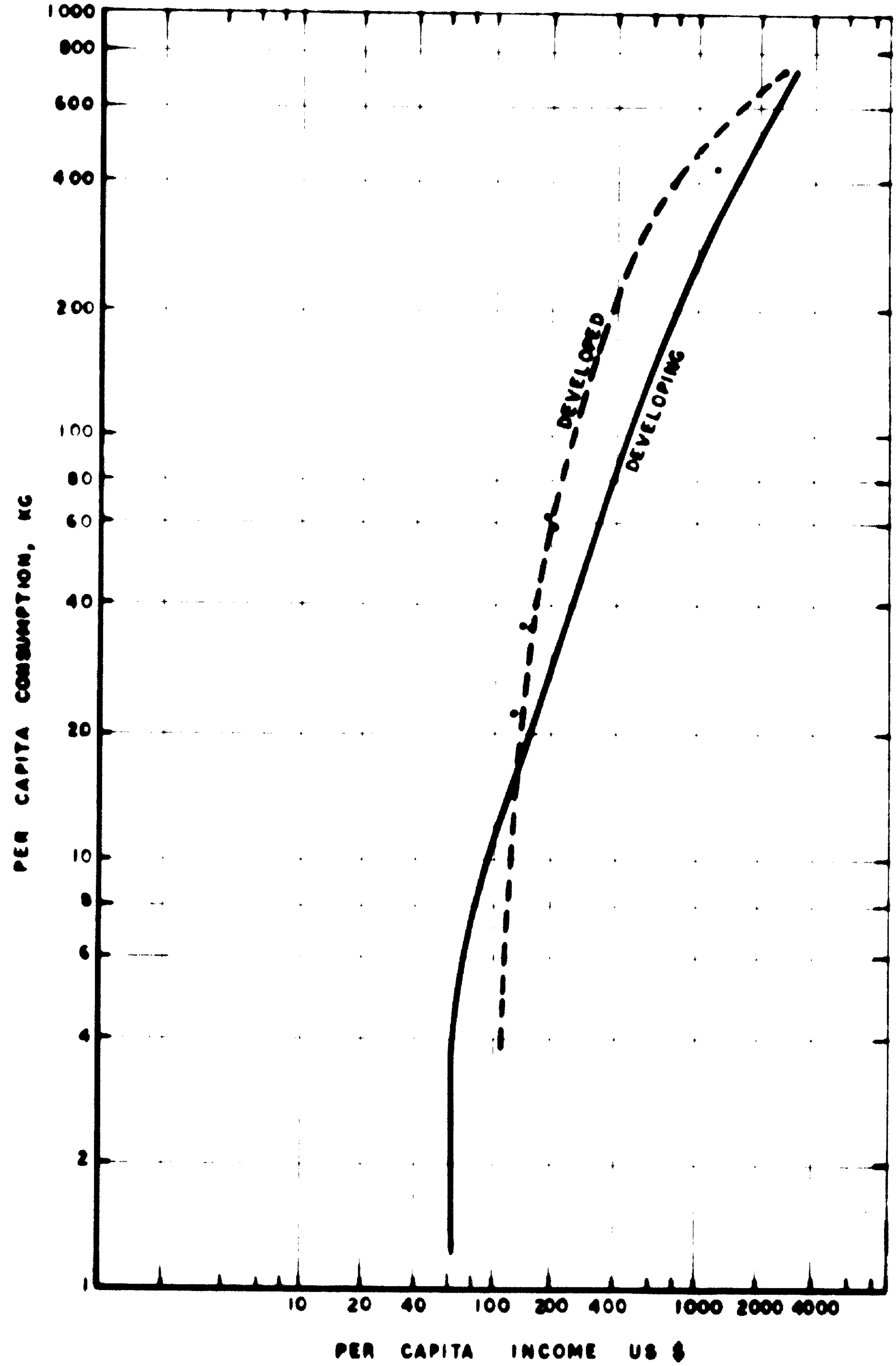


FIG 8-2: RELATION BETWEEN PER CAPITA STEEL CONSUMPTION AND PER CAPITA INCOME

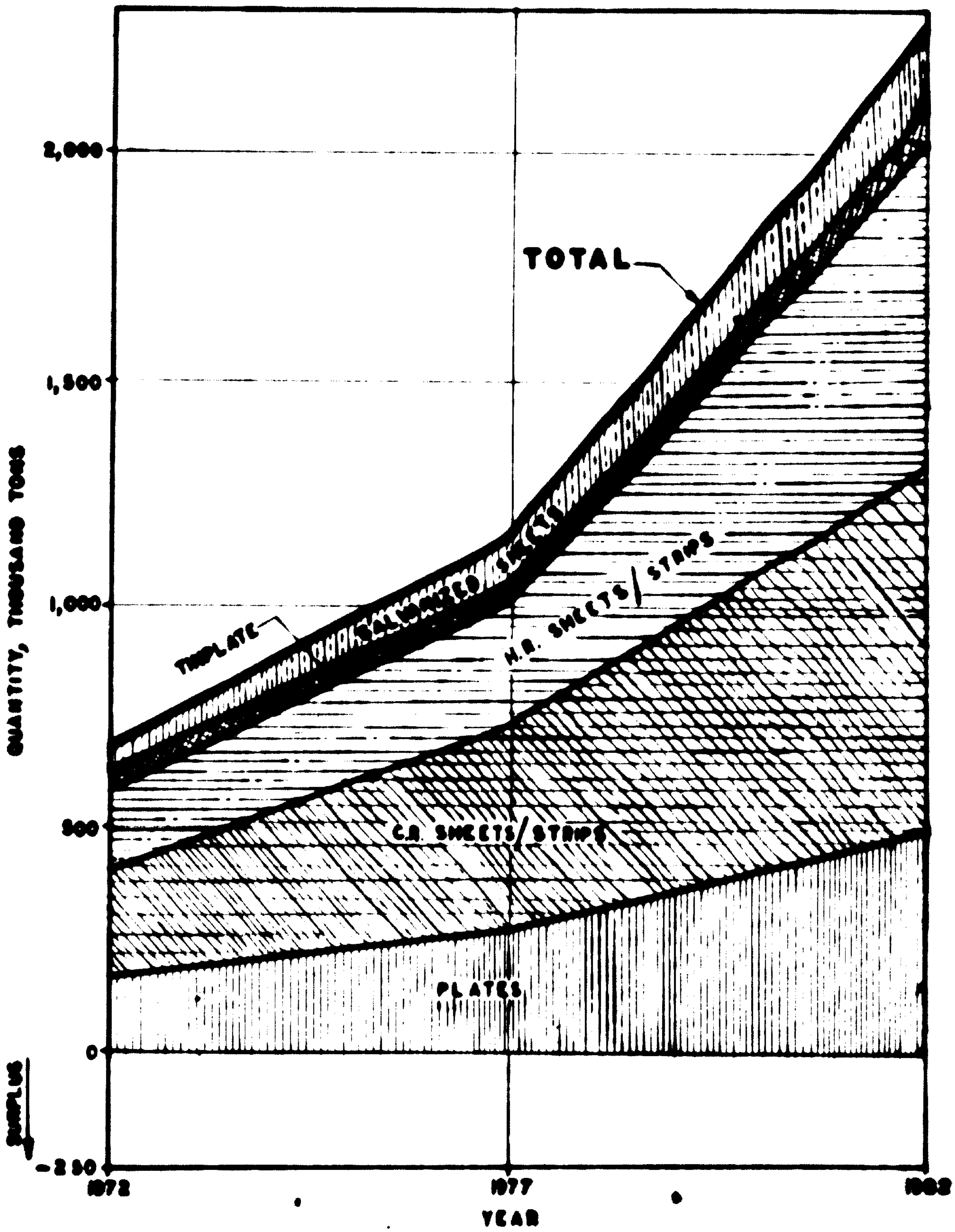


FIG. 9-2: SHORTFALLS OF FLAT PRODUCTS

9 - Analysis of shortfall (cont'd)

Flats, bars and rods

Probable demand, availability and shortfalls for flats, bars and rods are given in Table 9-9. Though indigenous production capacity will be considerable, there will be substantial shortfall in 1982.

Table 9-9

FLATS, BARS AND RODS: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

		Table	1972	1977	1982
Availability					
Primary producers			-	140.00	140.00
Secondary producers			210.00	260.00	260.00
Total availability		8-1	210.00	400.00	400.00
Demand	..	6-10	200.74	397.66	717.23
Export	..	7-3	-	-	0.20
Substitution	..	7-6	-	-	(-2.06)
Total demand			200.74	397.66	717.91
Shortfall			+9.26 a/	+2.34 a/	317.91

a/ + denotes surplus.

Assuming that the third rolling mill unit of Iranian Rolling Mills Co with an annual capacity of 150,000 tons of wire rods is erected and commissioned before 1972 and the unit produces 100,000 tons in 1972, there will be a small surplus of 9,260 tons of bars and rods. With the same will producing at full capacity of 150,000 tons per annum, there will be a surplus of 2,340 tons in 1977. By 1982, however, there will be a substantial shortfall of 317,910 tons.

9 - Analysis of shortfall (cont'd)

Wires

Probable demand, availability and shortfalls for wires are given in Table 9-10. The shortfalls have been calculated on the basis of a production capacity of 15,000 tons of wires, when the wire drawing plant of IMDBI is installed. In the year 1972, there will be a small surplus of 2,450 tons. Afterwards, there will be shortfalls of 7,380 tons and 35,664 tons by 1977 and 1982 respectively, unless new wire drawing capacity is created meanwhile.

Table 9-10

WIRES: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

	Table	1972	1977	1982
Availability				
Primary producers		-	-	-
Secondary producers		15.00	15.00	15.00
Total availability	8-1	15.00	15.00	15.00
Demand ..	6-10	12.55	22.38	50.66
Export substitution		-	-	-
Total demand		12.55	22.38	50.66
Shortfall		+2.45a/	7.38	35.66

a/ + denotes surplus

Fig. 9-3 shows the shortfalls of bars and rods and wires. There are small surpluses in 1972 and shortfalls in subsequent years.

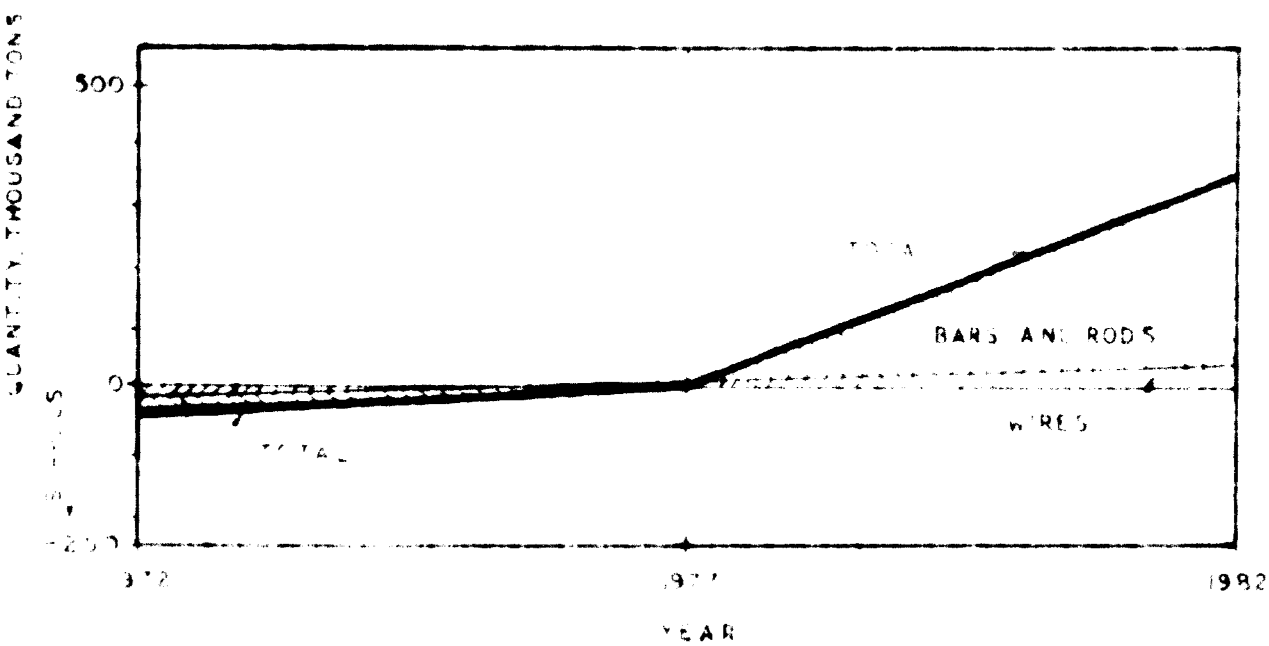


FIG 9-3 SHORTFALLS OF BARS, RODS AND WIRES

9 - Analysis of shortfall (cont'd)

Probable demand, availability and shortfalls of pipes and tubes are given in Table 9-11.

Table 9-11

PIPES AND TUBES: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

Availability	Table	1972	1977	1982
Primary producers		-	-	-
Secondary producers		345.00	453.00	453.00
Total availability a/	8-1	345.00	453.00	453.00
Demand		396.10	579.28	1 016.55
Export	7-3	-	-	5.00
Substitution	7-6	-	-	(-0.97)
Total demand		396.10	579.28	1 020.58
Shortfall		51.10	126.28	567.58

a/ The availability of 345,000 tons in 1972 is based on 310,000 tons from Ahwaz Pipe Mill producing at 85% of its initial capacity of 360,000 tons plus 35,000 tons from Sepanta Industrial and Commercial Co. The availability of 453,000 tons in 1977 and 1982 is based on 418,000 tons from Ahwaz Pipe Mill and IMDBI Pipe Mill producing at 85% of their installed capacities of 450,000 tons and 40,000 tons respectively, plus 35,000 tons from Sepanta.

9 - Analysis of shortfall (cont'd)

Types of pipes and tubes

Pipes and tubes required are of various types such as seamless tubes, welded pipes required for manufactured items and heavy pipes and tubes for oil, gas and water pipe lines. Breakdown of the total estimated demand for pipes and tubes in the above categories, including the demand for spares and maintenance, small scale industries and stocks, is given in Table 9-12.

Table 9-12

CATEGORIES OF PIPES AND TUBES

(in thousand tons)

Categories	1972	1977	1982
Seamless tubes	110.90	141.00	252.72
Pipes and tubes for manufactured items	53.20	97.28	163.23
Heavy pipes and tubes for oil, gas and water	232.00	341.00	604.63
Total	396.10	579.28	1 020.58

While Table 9-11 gives the overall demand, availability and shortfalls for pipes and tubes, it is more relevant to assess the shortfalls for different types of pipes and tubes, which are given in Table 9-13.

9 - Analysis of shortfall (cont'd)

Table 9-13

PIPES AND TUBES: DEMAND, AVAILABILITY AND SHORTFALLS BY TYPES

(in thousand tons)

Types of tubes	1972	1977	1982
Seamless tubes			
Demand	110.90	141.00	252.72
Availability	-	-	-
Shortfall	110.90	141.00	252.72
Welded pipes and tubes			
Demand	285.20	438.28	767.86
Availability	345.00	453.00	453.00
Shortfall	+59.80a/	+14.72a/	314.86
Total shortfall	51.10	126.28	567.58

a/ + denotes surplus

Shortfalls of seamless and welded pipes and tubes are shown in Fig. 9-4. There will be a surplus of welded pipes and tubes up to 1977 but thereafter there will be shortfalls rising upto 315,000 tons by 1982. In the case of seamless tubes, indigenous availability being nil, the entire demand is shortfall.

Semis for pipes and tubes

Semis required for the manufacture of seamless tubes are blooms and billets. The yield from semis to finished tube is about 80 per cent. On this basis, total blooms and billets required for the production of seamless tubes will be 138,600 tons, 176,250 tons and 315,900 tons

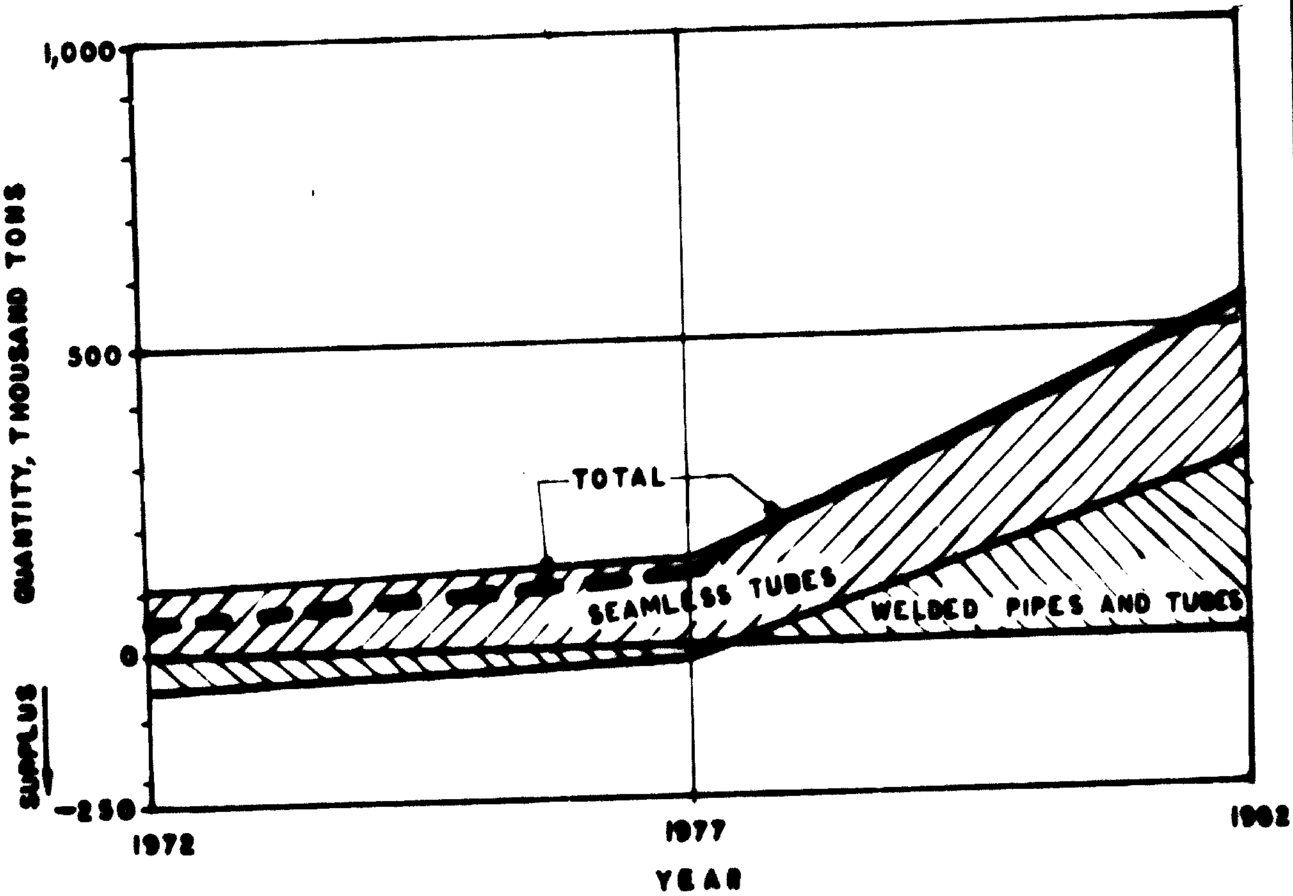


FIG. 9-4: SHORTFALLS OF PIPES AND TUBES

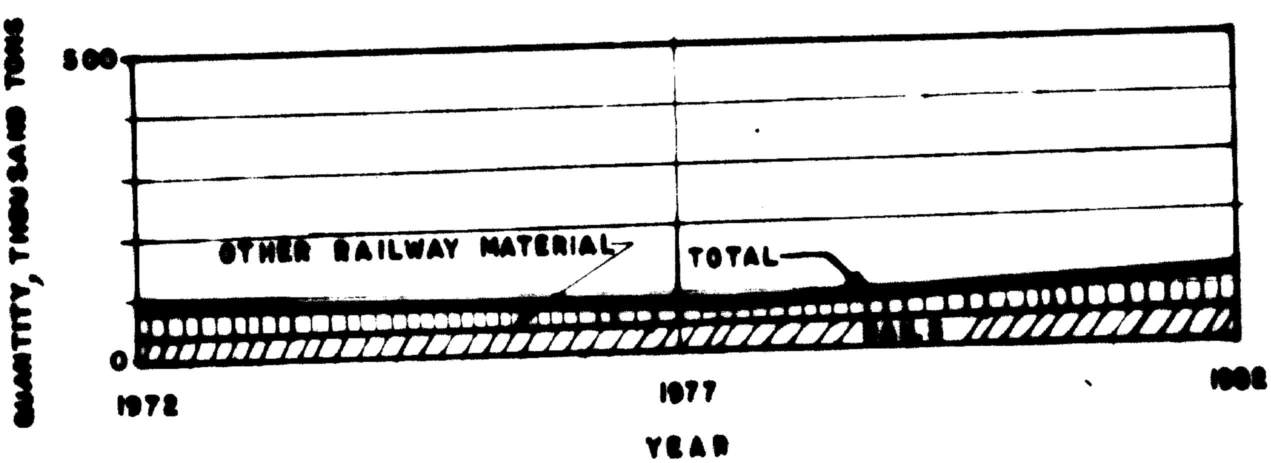


FIG. 9-5: SHORTFALLS OF RAILWAY MATERIALS

9 - Analysis of shortfall (cont'd)

respectively in 1972, 1977 and 1982. These tonnages of blooms and billets have been included in the estimated requirements of steel for the respective years given in Table 6-4.

Plates and strips are the semis required for heavy pipes and tubes. Yield of welded pipes and tubes is approximately 85 per cent. On this basis, the flat products requirements have been estimated as 106,600 tons of plates and 230,100 tons of hot rolled sheets and strips for 1972, 156,000 tons of plates and 359,500 tons of hot rolled sheets and strips for 1977, and 212,800 tons of plates and 685,800 tons of sheets and strips for 1982. These figures also have been included in the flat products requirements given in Table 6-4.

Welded pipes and tubes for manufactured items have, however, been shown as such in Table 6-4 without indicating the semis required. For these tubes also the semis required are flat products, and assuming 85 per cent yield from semis to fabricated tubes, the total requirement of flat products for these items will be 63,700 tons, 114,400 tons and 198,000 tons respectively in the years 1972, 1977 and 1982. These tonnages will have to be added to the total demand for flat products in order to arrive at the shortfall of flat

9 - Analysis of shortfall (cont'd)

products. This has been incorporated in Table 9-8 giving the demand, availability and shortfall for hot rolled sheets and strips.

Rails

Probable demand, availability and shortfalls for rails are given in Table 9-14.

Table 9-14

RAILS: DEMAND, AVAILABILITY AND SHORTFALLS
(in thousand tons)

	Table	1972	1977	1982
Availability				
Primary producer		-	5.00	5.00
Secondary producer		-	-	-
Total availability	8-1	-	5.00	5.00
Demand	6-10	41.04	36.72	62.78
Export	7-3	-	-	-
Substitution	7-6	x	x	x
Total demand		41.04	36.72	62.78
Shortfall		41.04	31.72	57.78

Railway materials

The demand of railway materials mainly comprises wheels and tyres, axles, sleepers, dog spikes etc. There is no indigenous production capacity and consequently the demand given in Table 6-4 is the shortfall.

Shortfalls of railway materials are shown in Fig 9-5. The drop in 197' is partly due to reduction in route km of

9 - ANALYSIS OF SHORTFALL

Demand

The steel demand estimates covering both tonnage and alloy steels including the demand for spares and maintenance, small and medium scale industries, and stock, are summarised in Table 8-1.

It must be emphasised that if the developmental projects visualised in this study are not implemented with due speed, then the steel demand would fall short of these estimates.

Availability

The availability of steel, based on the manufacturing programmes of the only primary producer, namely, the Isfahan Steel Plant and of the secondary producers has to be ascertained for estimating the shortfalls. A resume of the production capacities, existing as well as future, of primary and secondary producers is given below, based on available information. As plans are often changed, the estimates should be considered as tentative.

9 - Analysis of shortfall (cont'd)

railway line proposed to be laid and partly to the production of 5,000 tons of rails envisaged from Isfahan steel plant.

Ingots and semis

Probable demand, availability and shortfalls for ingots and semis are given in Table 9-15.

Table 9-15

INGOTS AND SEMIS: DEMAND, AVAILABILITY AND SHORTFALLS

(in thousand tons)

	Table	1972	1977	1982
Availability				
Primary producer		-	70.00	70.00
Secondary producer a/		-	150.00	150.00
Total availability	8-1	-	220.00	220.00
Demand by secondary producers				
Iranian Rolling Mills Co b/		278.00	333.00	333.00
Other plants c/		111.00	222.00	222.00
For seamless tube	6-10	138.60	176.25	315.90
Total		527.60	731.25	870,90
Export	7-3	-	-	48,00
Substitution	7-4	-	-	-
Total demand		527.60	731.25	918.90
Shortfall		527.60	511.25	698.90

a/ The expansion scheme of Iranian Rolling Mills Company under implementation consists of facilities for the production of 150,000 tons of continuous cast billets per annum. This output is expected to be achieved before 1977,

b/ Iranian Rolling Mills Co produce mainly bars and rods, Billets requirements have been estimated on the basis of 90% yield.

c/ The production from other plants is skelp/narrow strip for which skelp bars/slabs requirements have been estimated on the basis of 90% yield.

9 - Analysis of shortfall (cont'd)

Total shortfall

Summarising the Tables 9-2 to 9-15, categorywise and total shortfalls surpluses are given in Table 9-16.

In Table 9-16, pipes and tubes are not shown separately. Instead, the requirements of flat products in the form of plates, sheets/strips and skelps for welded pipes and tubes and the requirement of blooms and billets for seamless tubes have been included. The shortfalls in pipes and tubes have been dealt with earlier and given in Table 9-13.

Productwise and total shortfalls of tonnage steel are shown in Fig 9-6. The shortfalls of ingots and semis are also included. The total shortfall increases from 1.6 million ton in 1972 to 1.9 million ton in 1977, the reason for this low increase being that 650,000 tons of indigenously produced steel (430,000 tons of finished materials and 70,000 tons of billets from Isfahan steel plant and 150,000 tons of continuous cast billets from Iranian Rolling Mills Company) will become available between 1972 and 1977,

8 - Analysis of shortfall (cont'd)

Table 9-16

CATEGORYWISE SHORTFALLS OF TONNAGE STEEL
(in thousand tons)

Category	Table	1972	1977	1982
Structurals				
Beams	9-2	252.61	23.95	+19.62 a/
Channels	9-3	55.96	71.27	108.54
Angles	9-4	59.04	72.25	182.55
Tees	9-5	+0.97 a/	1.78	8.08
Sub-total		366.64	169.25	279.55
Flat products				
Plates	9-6 b/	171.98	282.90	496.59
C.R. sheets/strips	9-7	240.99	466.22	856.63
H.R. sheets/strips	9-8 c/	196.08	271.48	689.43
Tinplate		54.00	66.85	82.79
Galvanised sheets		44.01	81.52	140.67
Sub-total		707.06	1 171.97	2 266.11
Others				
Bars and rods	9-9	+9.26 a/	+2.34 a/	317.91
Wires	9-10	+2.45 a/	7.38	35.66
Sub-total		+11.71 a/	+5.04	353.57
Railway materials				
Rails	9-14	41.04	31.72	57.78
Other railway materials	6-4	39.43	35.30	60.38
Sub-total		80.47	67.02	118.16
Ingots and semis	9-15 d/	527.60	511.25	698.90
Total (excluding defence)		1 670.04	1 924.53	3 7[illegible].30
Rounded off		1 670.00	1 925.00	3 716.00

a/ + denotes surplus

b/ The requirements of 106,000 tons, 156,000 tons and 212,800 tons of plates required for heavy pipes and tubes for the years 1972 1977, and 1982 respectively have been taken into consideration in calculating the shortfalls.

c/ The requirements of 230,100 tons, 359,500 tons and 685,800 tons of hot rolled sheets and strips for heavy pipes and tubes for the years 1972, 1977 and 1982 respectively have been taken into consideration in calculating the shortfalls.

d/ The requirements of 138,600 tons, 176,250 tons and 315,900 tons of semis for seamless tubes for the years 1972, 1977 and 1982 respectively have been taken into consideration in calculating the shortfalls.

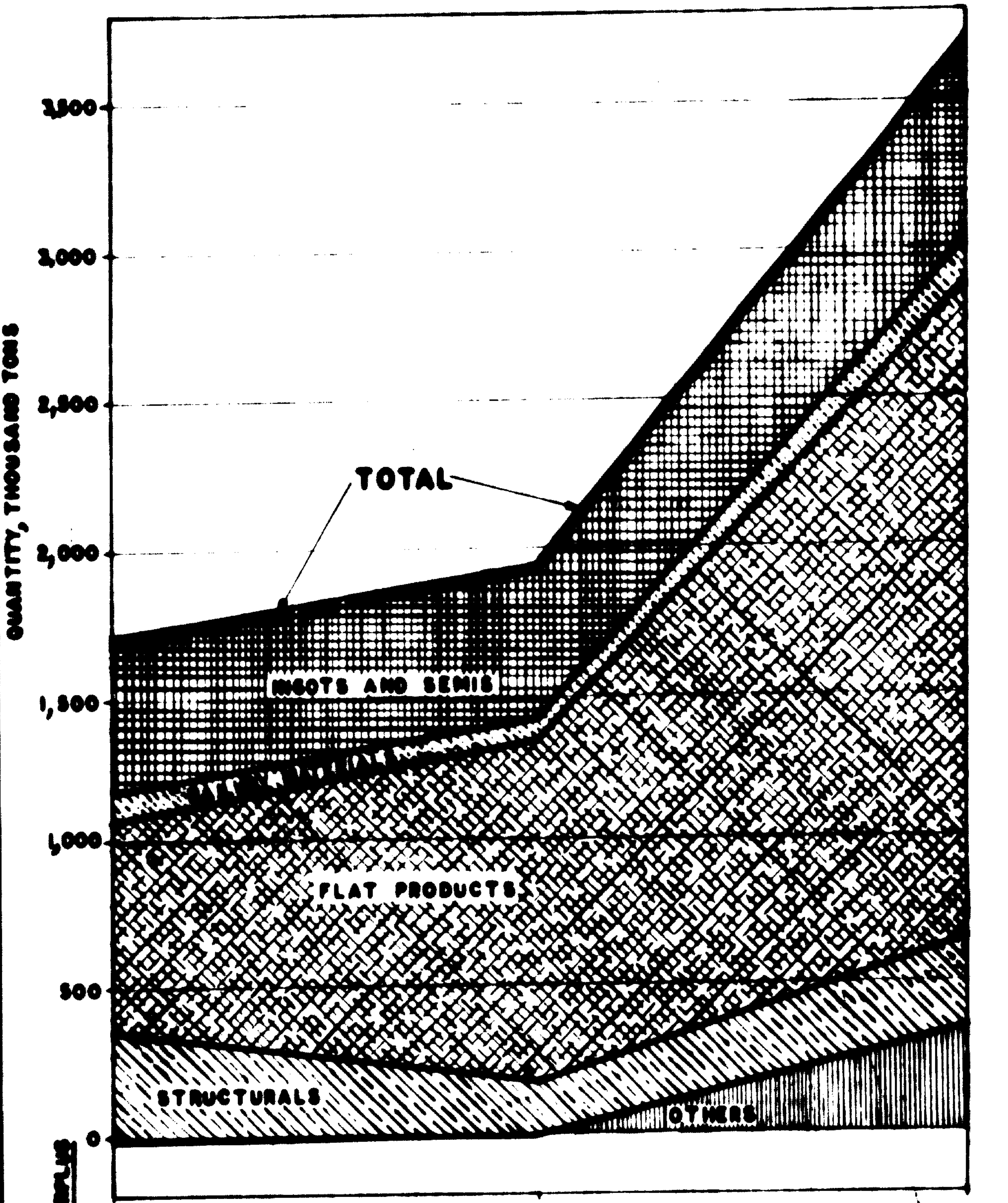


FIG. 9-6: SHORTFALLS OF TONNAGE STEEL

8 - Analysis of shortfall (cont'd)

Sizewise breakdown of shortfalls/surpluses in different categories of tonnage steel products are given in Table 9-17. The shortfalls/surpluses indicate the direction which planning for additional steel capacity in Iran should take. It is interesting to note that if 234,000 tons of beams are continued to be produced by the Isfahan steel plant according to its present product-mix, there may be a surplus of this product; but it should be possible to switch over to the production of other structural sections or rails on the same section mill, with minor modifications and additional finishing facilities. In the case of channels and angles however the substantial shortfalls would call for setting up of additional capacity.

The considerable shortfall of 710,000 tons of flat products by 1972, which rises to 2,266,000 tons by 1982, would justify setting up of a separate integrated steel plant for flat products only. In case of welded pipes and tubes, there is some surplus capacity in 1972 and 1977. Additional capacity would need to be set up to meet the shortfalls of 310,000 tons by 1982. Installation of capacity for seamless tube production needs consideration.

SECTION 1

Table 9-17

SIZEWISE BREAKDOWN OF SHORTFALLS IN DIFFERENT CATEGORIES

(in thousand tons)

Category	Sizes	1972	1977	1982
Structurals				
Beams:		252.61	23.95	+19.62 a/
	a) 100 x 50 - 150 x 80	27.17	-	-
	b) 175 x 90 - 250 x 125	66.44	-	-
	c) 300 x 140 - 450 x 150	140.00	-	-
	d) Above 450 x 150	19.00	-	-
Channels:		55.96	71.27	108.54
	a) 30 x 33 - 60 x 45	9.00	12.60	25.54
	b) 100 x 50 - 150 x 75	21.96	28.17	38.00
	c) 175 x 75 - 400 x 100	25.00	30.50	45.00
Angles:		59.04	72.25	182.55
i) Equal angles		49.49	59.00	150.00
	a) 20 x 20 - 90 x 90	38.79	43.60	120.00
	b) 100 x 100 - 110 x 110	4.70	5.90	13.00
	c) 130 x 130 - 200 x 200	6.00	9.50	17.00
ii) Unequal angles		10.50	13.25	32.55
	a) 30 x 20 - 60 x 40	2.00	2.50	5.25
	b) 85 x 45 - 125 x 75	5.00	6.50	16.80
	c) 125 x 90 - 200 x 150	3.50	4.25	10.50
Tees:		+0.97 a/	1.78	8.08
Sub-total		366.64	169.25	279.55
Flat products				
Plates:		171.98	282.90	496.59
	a) 900 - 1 100 width	55.50	88.30	196.50
	b) 1 250 - 1 600 width	90.28	150.00	230.00
	c) 1 800 - 2 795 width	26.20	44.60	70.09
C.R. sheets/strips:		240.99	466.22	856.63
	a) 600 - 1 100 width	180.00	325.00	590.50
	b) 1 200 - 1 525 width	60.99	141.22	266.13
H.R. sheets/strips:		196.08	274.48	689.43
	a) 600 - 1 100 width	175.00	235.00	575.00
	b) 1 200 - 1 525 width	21.08	39.48	114.43

C.R. sheets/strips:		240.99	466.22	856.63
	a) 600 - 1 100 width	180.00	325.00	590.50
	b) 1 200 - 1 525 width	60.99	141.22	266.13
H.R. sheets/strips:		196.08	274.48	689.43
	a) 600 - 1 100 width	175.00	235.00	575.00
	b) 1 200 - 1 525 width	21.08	39.48	114.43
Tinplate:		54.00	66.85	82.79
Galvanised sheets:		44.01	81.53	140.67
Sub-total		797.06	1 171.97	2 266.11
Other products				
Bars and rods:		+9.26 a/	+2.34 a/	317.91
i) Rounds and squares:		-	-	249.80
	a) below 12	-	-	105.00
	b) 12 - 50	-	-	120.50
	c) above 50	-	-	24.30
ii) Flats:		-	-	68.11
	a) 25 - 50 width	-	-	35.90
	b) 50 - 125 width	-	-	20.00
	c) 125 - 250 width	-	-	12.21
Wires:		+2.45 a/	7.38	35.66
Sub-total		+11.71 a/	5.04	353.57
Railway materials				
Rails:		41.04	31.72	57.78
Other railway items		39.43	35.30	60.38
Sub-total		80.47	67.02	118.16
Ingots and semis:		527.60	511.25	698.90
Total		1 670.04	1 924.53	3 716.30
Rounded off		1 670.00	1 925.00	3 716.00

a/ = denotes surplus

9 - Analysis of shortfall (cont'd)

Alloy steels shortfall

So far as alloy steels are concerned, no production capacity is likely to materialise in the immediate future. A beginning has been made in this direction with the feasibility study prepared by us for the Ministry of Economy. But it is not known when and by when this alloy steels plant will be set up. The demand estimates given in Table 6-19 indicate the probable shortfalls in the years under study.

The shortfalls of alloy steels, broken down into flat and non-flat products, are given in Table 9-18.

It may be noted that about 76 per cent of the total alloy steel demand is in non-flat category. Taking together all the other steels except stainless and electrical sheet steel, about 90 per cent of total demand is in non-flat category. In the case of stainless steel, flat products constitute 72 per cent, and in electrical steel the entire consumption is in flat products.

9 - Analysis of shortfall (cont'd)

Table 9-18

SHORTFALLS OF ALLOY STEELS IN FLAT AND NON-FLAT CATEGORIES

(in thousand tons)

Type of steel	1972 Non-flat	1972 Flat	1972 Total	1977 Non-flat	1977 Flat	1977 Total	1982 Non-flat	1982 Flat	1982 Total
Carbon constructional	3.45	0.30	3.75	8.20	0.95	9.15	13.50	1.73	15.23
Free cutting	1.82	-	1.82	4.27	-	4.27	7.42	-	7.42
Spring	13.30	0.24	13.54	26.20	0.87	27.07	43.00	2.24	45.24
Alloy constructional	14.50	1.99	16.49	33.60	4.54	38.14	52.40	7.89	60.29
Stainless	1.25	3.50	4.75	3.02	6.70	9.72	4.57	11.50	16.07
Electrical sheet	-	3.72	3.72	-	7.07	7.07	-	10.37	10.37
Tool	1.60	0.68	2.28	3.00	1.00	4.00	3.90	1.14	5.04
Die blocks	0.32	-	0.32	0.50	-	0.50	0.84	-	0.84
Total	36.24	10.43	46.67	78.79	21.13	99.92	125.63	34.87	160.50

10 - DEVELOPMENT OF STEEL INDUSTRY

Steel, by reason of its comparatively low cost and high degree of versatility as an engineering material, provides the take-off point for numerous light, medium and heavy industries. At the same time, the exacting technology of making, shaping and treating of steel necessitates inputs of a multitude of products in the form of raw materials, consumable supplies, materials for repairs, maintenance and spares, from the mining and manufacturing sectors. Massive investments in the capital intensive steel industry remain largely idle and infructuous if they are not supported by industries which complete this network of forward and backward linkage.

Vertical and horizontal combinations of industries

Lists of typical feeder, steel consuming and by-product industries that cluster around the nucleus of a ferrous metallurgical plant are presented in Tables 10-1, 10-2 and 10-3. Apart from such vertically linked industries, alloy and tool steel production, iron and steel foundries, forge plants, and plants for the

9 - Analysis of shortfall (cont'd)

Isfahan steel plant

At the end of 1965, preparatory work in collaboration with USSR began for the construction of the first steel mill near Isfahan with an initial annual capacity of 500,000 tons to 600,000 tons of steel, to be later expanded to 1.2 million tons and over. The product-mix envisaged for the initial stage is given below:

		Finished steel tons/yr
Structurals	..	280 000
Hoops and strips	..	5 000
Bars, rods and flats	..	140 000
Billets	..	70 000
Light rails	..	5 000
Total	..	500 000

Iranian Rolling Mills Co

The Iranian Rolling Mills Company is situated 9 km south of Ahwaz. The mill has three units, the first of which was established in 1967 for the manufacture of rounds and light sections. During 1968, the mill operated at full rated capacity of 65,000 tons per year. The second unit for the manufacture of reinforcing bars was established in 1968 and it is expected that full production of 85,000 tons of bars and rods will be achieved in 1970. The finishing train of the third mill for manufacturing 150,000 tons of wire rods per year is under erection. The roughing and intermediate trains are in the planning stage. Sixtyfive

10 - Development of steel industry (cont'd)

manufacture of wheels, tyres, axles and other railway materials flourish in both vertical and horisontal combination.

Table 10-1

SOME TYPICAL FEEDER INDUSTRIES

Metallic materials	Non-metallic materials
1. Mining of ores	1. Mining of coal, flux and refractory raw materials
2. Ore beneficiation	2. Coal washeries
3. Agglomeration processes such as sintering and pelletisation	3. Raw materials beneficiation
4. Sponge iron	
5. Ferro-alloys	

Consumable materials	Repair and maintenance materials
1. Electrodes, electrode paste	1. Fast wearing components: Mill rolls.
2. Pickling acids	2. Maintenance materials: Refractories, ingot moulds, etc.

10 - Development of steel industry (cont'd)

Table 10-2

TYPICAL INDUSTRIES CONSUMING STEEL PLANT PRODUCTS

Tonnage steels

Semis	Finished products: Non-flat	Finished products: Flat
1. Re-rolling mills	1. Fabricated structural steelwork	1. Welded pipes and tubes
2. Wire-drawing units	2. Fasteners like bolts, rivets and washers	2. Penstocks
3. Seamless tube plants	3. Wire nails	3. Steel furniture
4. Permanent way steel sleepers	4. Permanent way points and crossings	4. Expanded metal
5. Cold drawn bars	5. Forgings	5. Tanks
6. Axles for railway wagons	6. Agricultural implements	6. Gas cylinders
7. Forgings	7. Link chains	7. Drums and containers
		8. Builders' hardware
		9. Enamel ware
		10. Profile sections
		11. Equipment for chemical plants and refineries
		12. Welded steel sections

Alloy steels

Semis	Finished Products: Non-flat	Finished Products: Flat
1. Cold drawn bars	1. Roller chains	1. Welded pipes and tubes
2. Seamless tubes	2. High tensile and precision fasteners	2. Stainless steel utensils
	3. Forgings	3. Hacksaw and band saw blades
	4. Metal cutting and forming tools	4. Razor blades
	5. Hand-tools	5. Equipment for chemical plants and refineries
	6. Springs (automobiles and railways)	6. Roller chains
	7. Link chains	
	8. Cutlery, surgical instruments (stainless as well as others)	

Table 10-3

TYPICAL BY-PRODUCT BASED INDUSTRIES

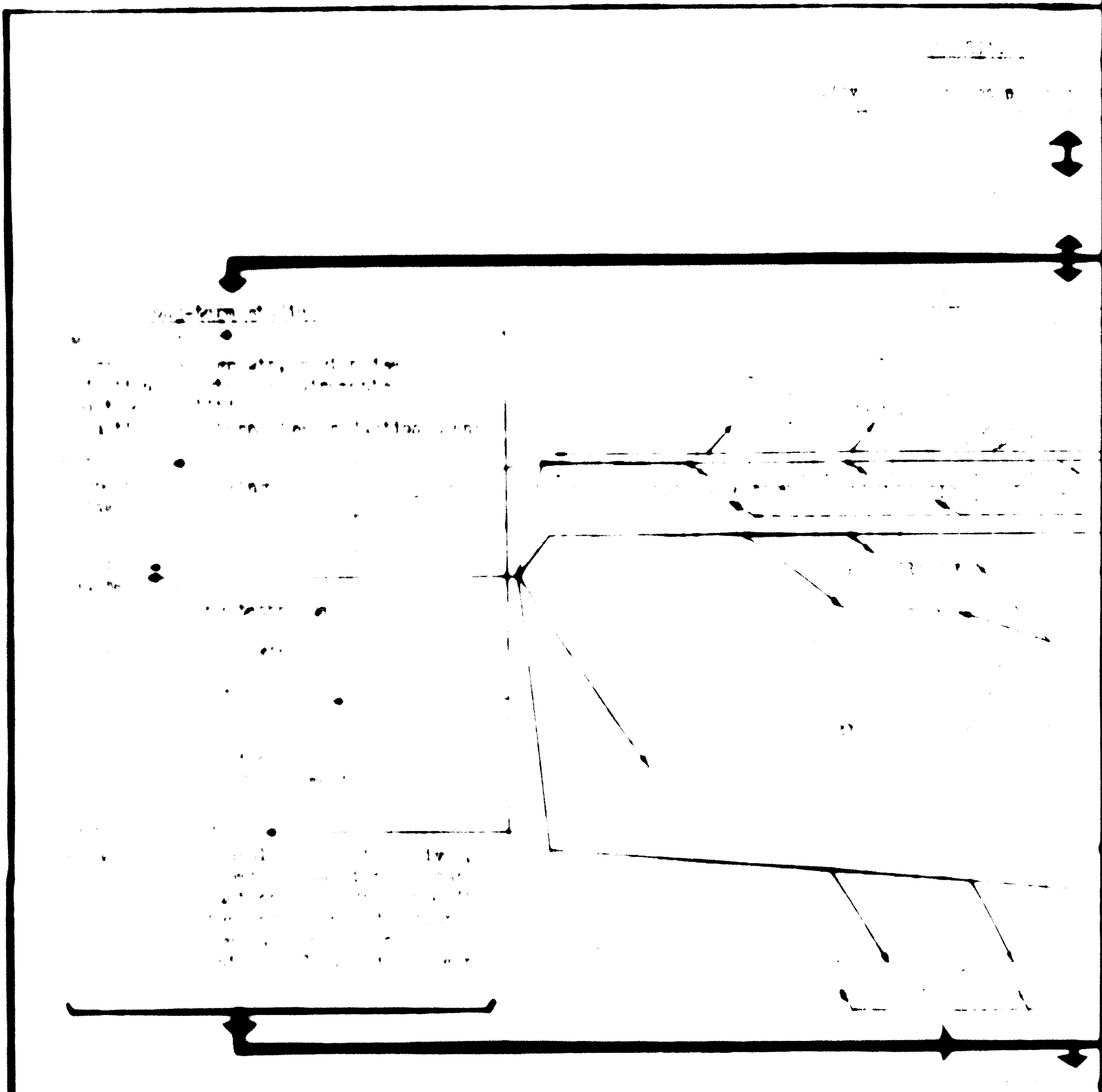
Metallic by-products	Nonmetallic by-products
1. Scrap re-rolling	1. Blast furnace slag cement
2. Plant for scrap recovery	2. Coke oven by-products: Gas and tar recovery, tar distillation, nitrogenous fertiliser production supplemented by nitrogen supply from the oxygen plant
	3. Recovery of benzene, toluene, xylene, etc.

Balanced development

Balanced development of these industries can be best ensured by long-term perspective planning for each development sector on the pattern suggested in the chart given in Figure 10-1.

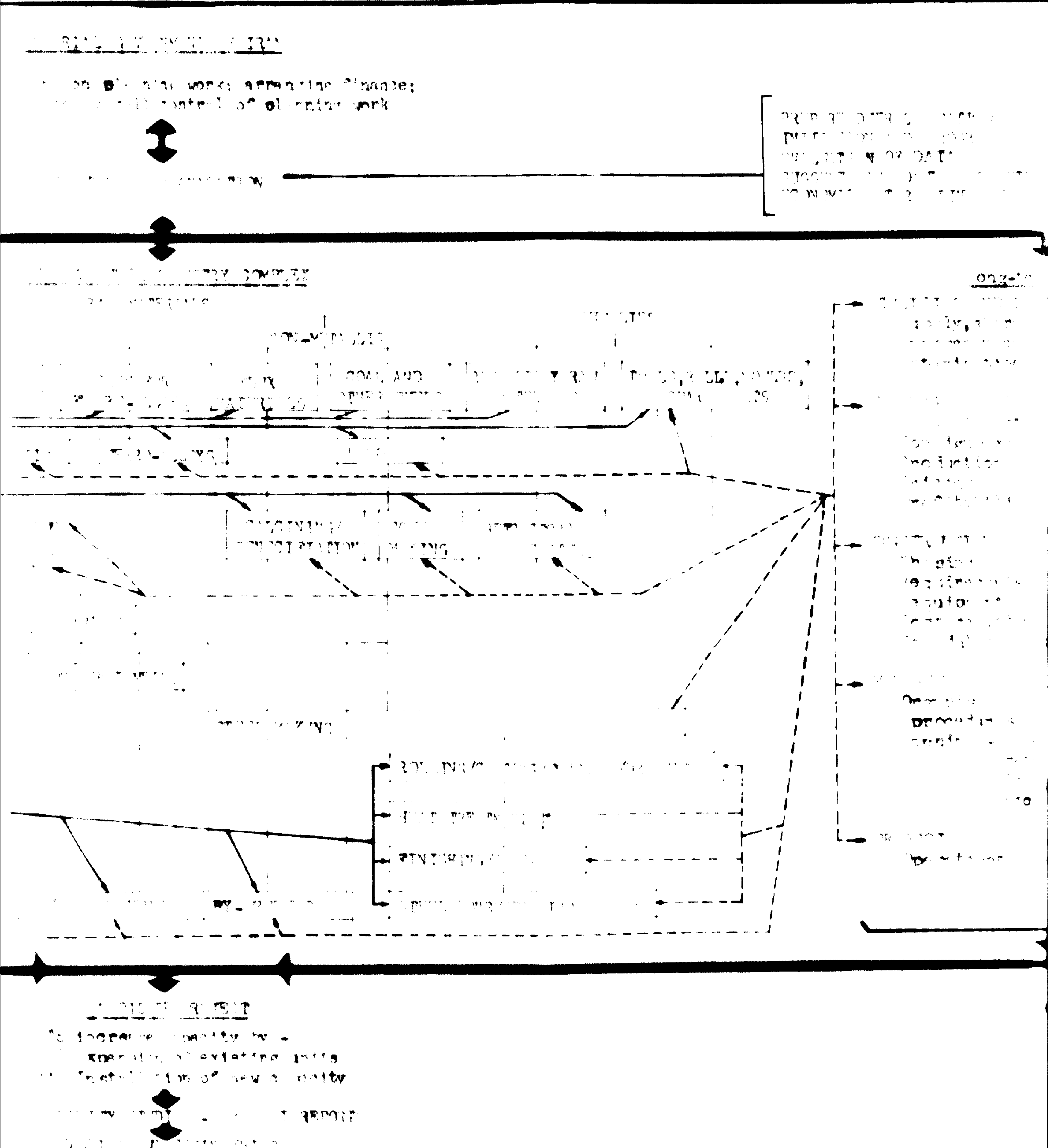
Output targets

The output targets selected for steel and related industries on the basis of the steel demand figures estimated by this study and the present pattern of development obtaining in Iran are outlined in Table 10-4.



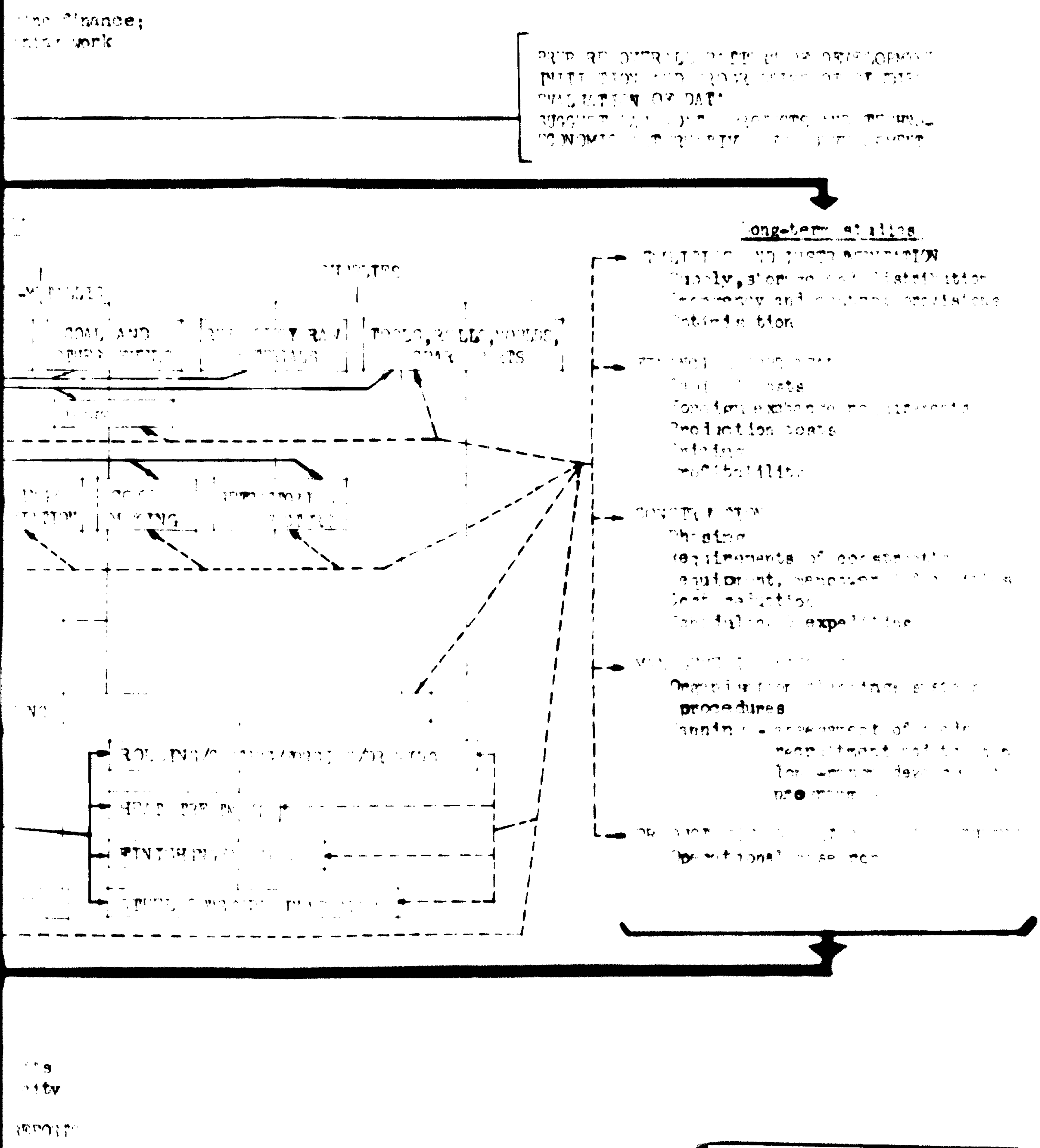
SECTION 1

FIG 10-1. PERSPECTIVE PLANNING FOR



arranging finance;
control of planning work
COAL AND
existing units

SECTION 2


Long-term studies
COAL AND
TOOLS, ROLLS, MOULDS,
Production costs
procedures

SECTION 3

SECTION 1

Table 10-4

SELECTED PRODUCTION TARGETS FOR STEEL AND RELATED INDUSTRIES

Item	1977			1982		
	Demand Forecast	Production target		Demand Forecast	Production target	
		Liquid steel	Finished product		Liquid steel	Finished product
	tons	tons	tons	tons	tons	tons
Tonnage steel:						
1) integrated, ore based) 2) semi-integrated, scrap based)	2.50 million	3.0 million	2.4 million	4.2 million	5.0 million	4.0 million
		150 000	135 000		300 000	270 000
Alloy steel	99 920	90 000	60 000	160 500	150 000	100 000
Steel castings	9 000	15 000	7 500	15 000	24 000	12 000
Malleable iron castings	14 600		10 000	26 000		18 000
Grey iron castings (industrial and engineering castings)	130 800		90 000	208 400		150 000
Ferro-alloys a/						
Ferro-manganese b/	32 000		38 000	54 000		55 000
Ferro-silicon c/ 75% grade	11 000		17 000	18 900		17 000
Ferro-chrome c/						
Low carbon	360		10 000	600		10 000
High carbon	-		4 500	-		4 500

a/ The demand forecast for ferro-alloys are as worked out in Tables 10-23 and 10-24.

b/ The surplus of ferro-manganese production over the internal demand is assumed to be exported at a loss

75% grade	[illegible]	[illegible]	[illegible]	17 000
Ferro-chrome c/				
Low carbon	360	10 000	600	10 000
High carbon	-	4 500	-	4 500

a/ The demand forecast for ferro-alloys are as worked out in Tables 10-23 and 10-24.

b/ The surplus of ferro-manganese production over the internal demand is assumed to be exported at a loss to earn foreign exchange sometime upto 1979.

c/ The surplus of ferro-silicon and ferro-chrome production over the internal demand represents export.

10 - Development of steel industry (cont'd)

Technological inputs

Technological inputs of critical importance for rapid and balanced development of the entire gamut of steel and related industries are:

i) raw materials
ii) services like power, transport and utilities, and
iii) trained manpower

Salient features of these inputs are briefly discussed below.

Raw materials

Requirements

On the basis of information presently available, a breakdown of the major raw material requirements for achieving the selected production targets by the years 1977 and 1982 is indicated in Appendix 10-1 and summarised in Table 10-5. The requirements of materials for the production of primary ore-based steel have been worked out on the basis of practice envisaged for the first stage of the Isfahan Steel Plant (excluding ferro-alloys).

Development of raw materials

The development of various mineral resources like iron and manganese ores, chromite, coal, limestone, etc has to be planned and implemented to meet the requirements of the production targets of the steel industry in 1977 and 1982.

Iron ore

Of the known occurrences of iron ore in Iran, the notable deposits are those near Semnan, Shamsabad near Arak and Bafq - Chogart region including Chandor-Malu (near Yazd). Noteworthy features of these deposits are reviewed in Table 10-6.

10 - Development of steel industry (cont'd)

Table 10-5

ESTIMATED INPUTS OF MAJOR RAW MATERIALS

	1977 '000 tons	1982 '000 tons
Metallic materials		
Ferrous:		
Iron ore (62% Fe)	4 131	6 917
Iron ore steelmelt shop grade	68	115
Pig iron	68	106
Steel scrap	301	550
Cast iron scrap	16	34
Malleable iron scrap	2.8	5.0
Non-ferrous:		
Manganese ore (low grade	135	224
Manganese ore (46% Mn content)	85	123
Chrome ore (Cr_2O_3 48%)	35	35
Non-metallic materials		
Quartzite (SiO_2 96%)	173	260
Solid fuels/reductants		
Coking coal (dry basis)	2 848	4 748
Coke	63	93
Charcoal	14	14
Fluxes		
Blast furnace grade limestone	791	1 301
Steelmelt shop grade limestone	513	861
Bauxite	45	75
Fluorspar	2.6	4.8
Ferro-alloys		
Ferro-silicon - 75% grade	11.1	19.0
Ferro-manganese - 75% grade	32	54
Ferro-chrome	0.4	0.6
Miscellaneous		
Moulding sand	61	103
Electrodes	2.0	3.6
Electrode paste	2.8	3.2
Refractories		
Dolomite	109	184
Other refractory bricks	64.8	108.7

9 - Analysis of shortfall (cont'd)

per cent of production capacity from the third mill may be achieved by 1972, and full production in subsequent years. The company is also planning to install a wire drawing unit with an annual capacity of 15,000 tons by end 1971, which will utilise wire rods produced in the wire rod mill.

Apart from the rolling mills, the company is planning to produce continuously cast billets at the rate of 150,000 tons per year by 1977. The present production and future programme of the Iranian Rolling Mills Company are given below:

Plant units	Type of mill	Production 1969 tons	1972 tons	1977 tons	1982 tons
First	Light section mill	65 000	65 000	65 000	65 000
Second	Merchant bar mill	-	85 000	85 000	85 000
Third	Continuous wire rod mill and wire drawing unit	-	100 000	150 000	150 000
	Total	65 000	250 000	300 000	300 000
Planned	Steelmaking and contiuous casting of billets			150 000	150 000

Ahwaz pipe mill

To meet the growing demand for pipes and tubes by the oil and gas industries of Iran, NIOC installed a pipe plant at Ahwaz. The installed capacity and production in

Table 10-6

IRON ORE DEPOSITS IN IRAN

Location	Status of development	Mineralogy	Chemical analysis	Estimated reserves	Remarks
To the north and east of Semnan	Investigated before the First World War	Magnetite and haematite	Fe:60 to 67 a/ Mn:0.7 to 2 SiO_2 and Al_2O_3 = 2 (average) CaO + MgO = 1 to 1.6 P_2O_5 - 0.002 to 0.003	3 million	Reserves are inadequate
Near Shamsabad	Beneficiation tests in 1959-61 were unsuccessful as Fe content could not be increased with lowering of the copper content to the acceptable limit	Mainly siderite and limonite with and admixture of copper-bearing minerals; the gangue mainly consists of quartz and calcite	Fe:28.4 to 50 SiO_2:5 to 19.5 CaO:1.4 to 25 MnO:4.1 to 5.3 P_2O_5:0.05	48 million	Found unsuitable for processing in steel plants as established by test results
Bafq - Chogart region	Exploration by the National Iranian Steel Corporation is in progress	Mainly magnetite, haematite and goethite; titanium in the form of limenite is intermixed with magnetite; the ores exhibit various degree of martitisation; the gangue consists of silicates and phosphates in the form of apatite	Fe:62 average SiO_2:6.61 P_2O_5:0.57 TiO_2:1.0	Possible: 400 million Indicated 71.5 million Proved: 49.1 million	Selected to feed Isfahan Steel Plant under construction

Source: Geological Survey or Iran, Rep.7 1965 - Ministry of Economy, Government of Iran

a/ The analysis pertains to magnetite

10 - Development of steel industry (cont'd)

It is necessary to establish mineral recovery conforming to grade requirements of iron and steel-making and set up mining installations compatible with the quantum of mineable reserves.

Coal

The characteristics of the two major coal fields in the country are shown in Table 10-7.

Table 10-7

FEATURES OF MAJOR COALFIELDS

Particulars	Elburs coalfield	Kerman coalfield
Location	Elburs range in the north	Kerman area in the South-Central Iran
Notable areas	Zeerab, Elika, Gajareh, Ghashlagu, Chesmeh-Got, Agdarband and Sanjrond	Sarkud
Type of coal	Except for some seams of good coking quality, the rest are non-coking	Non-coking coal is interspersed with seams of coking coal
Estimated reserves	Not-known	100 million tons total, out of which tentatively 40 million tons may be of coking variety
Ash content	10 to 25 per cent	10 to 25 per cent

10 - Development of steel industry (cont'd)

Detailed exploration of Kerman coal fields is being carried out by the National Iranian Steel Company with a view to meet the coke requirements for the first stage of the Isfahan Steel Plant. It has been tentatively established by preliminary tests that a blend of coals from three areas viz. Tannel Ravar, Babmisu and Khojedk with the following analysis will be suitable for coke making.

Ash content	- 10 to 11%
Sulphur	- 1.4 to 1.6%
Volatile materials	- 28 to 29%
Moisture content	- 8 to 9%

It is probable that Iran may be able to develop her own resources to meet increased coke requirements by 1977 and 1982 by accelerating geological investigations in the northern and south-central parts of the country and improvement of mining methods.

Limestone

Limestone occurs extensively in the northern, western and southern parts of the country, but details regarding reserves and grades are not available. The geological investigations carried out by the National Iranian Steel Company indicate that the reserves of blast furnace and steelmelt shop grade limestone near Isfahan Steel Plant may be placed at 41 million tons. It is likely that the anticipated requirements of limestone in 1977 and 1982 can be met by following up geological investigations in depth and adoption of proper mining methods.

10 - Development of steel industry (cont'd)

Dolomite

Estimates of dolomite reserves are not available and further geological investigation is necessary in this direction.

Manganese ore

Although various minor occurrences of manganese ore deposits have been reported in the northern and the north-central parts of Iran, the notable areas are in Sabzevar, Robat Karim, Ghom and Ardestan. Amongst these, only the Shah Rokh deposits in Ghom area are being mined at present, the other deposits having been abandoned in the past.

The manganese content of the Shah Rokh ores varies from 32 to 44 per cent, the average tenor being 38 per cent. (Attempts to beneficiate ores from other deposits with 24 per cent to 34 per cent manganese content were unsuccessful as the greater part of free manganese was lost in slimes). Though the manganese ore deposits in Iran are of volcanic origin, they may prove significant like their counterparts in Mexico.

The current estimates of reserves are as follows:

Shah Rokh deposits	:	Proved reserves - 0.2 million tons
		Possible reserves - 0.5 to 1 million tons
Other deposits	:	Reserves yet to be established.

Further efforts need to be directed towards systematic geological investigation of manganese ore deposits and intensification of mining activity on Shah Rokh deposits in Ghome area.

Quartsite

The present quarrying operations for quartsite are confined to two regions (i) to the north of Ghasvin and north-west of Teheran and (ii) Ghasemabad - Latian area to the north-east of Teheran. The quartsite reserves in the first area are estimated at 3 million tons and those in the second region are relatively very small. New quartsite deposits have been located around Tabas, Zefreh and Lachoulle near Isfahan by the National Iranian Steel Company. Reserves of these new deposits are estimated at 3 million tons. The samples of quartsite from Tabas and Lachoulle show SiO_2 content of 81.27 per cent and 93.3/97.7 per cent respectively.

Bauxite and Fireclays

Occurrences of bauxite and fireclays have been reported in some parts of the country. The findings are preliminary in nature and have to be followed up by investigations in depth to determine their grade and mineability.

Fluorspar

No geological investigations have so far been conducted for locating fluorspar deposits in the country and it is suggested that its availability should be investigated.

Electric power

Requirements

The power requirements for different iron and steel based industries are given in Table 10-8. The estimated 15 minute maximum demand has been computed on the basis of the proposed production capacity of various units and the unit energy consumption rates. The actual power consumption would however depend on several factors associated with the operation of various constituent units of each plant.

Power grid system

Since the Third Plan period (19[illegible] to 19[illegible]) steps have been taken by the Ministry of Water & Power to install a national grid to link up major generating centres over 400, 230, 132 and 66 KV transmission line network. The major objectives during the subsequent plan periods upto 1987 are to increase the generating capacity to meet the likely demand growth and expand the transmission line network on country-wide basis.

With the installation of large-scale generating stations in various regions specially Isfahan, Teheran, Khuzestan Water and Power Authority (KWPA) etc and their link-up to the national grid, it is probable that bulk power required by various iron and steel industries enumerated in Table 10-8 would be available. Depending on the individual plant production capacity and its proposed location, the question of power availability can be scrutinised at the project stage.

SECTION 1

Table [illegible]

[illegible]

[illegible]	[illegible]	[illegible]		[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 200 300	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11

[illegible]	Refractory bricks	[illegible]	25 000	0.5	75 000	1.5
10	Secondary tonnage steel processing industries	Distributed over the country	2 100 000	125	4 200 000	[illegible]
11	Secondary alloy steel processing industries	Distributed over the country	100 000	6	200 000	11
	Total			380		864
	Say			520		840

a/ The consumption of power in the mining of iron, manganese and other ores is generally of the order of 15 kWh/ton of ore. As captive power generators are installed at most of the mines to [illegible] this power, the power requirements for mining operations have been excluded.

Table 10-8

SECTION 2

Voltage selection

One of the important aspects of a well-planned, stable electrical power system for steel plants and other allied industries is the selection of power system voltages within the plant and the voltages at which power will be purchased from the regional electric supply company.

Inter-regional link-up is mainly over 400, 230 and 132 kV transmission lines. However, transmission of small blocks of power for short distances from the supply company's substation to plant site will be at lower HT voltages such as 63, 33, 20, or 11 kV. The voltage at which power will be purchased will depend on the standardised distribution voltages adopted by the supply company in the selected area.

Transport

Materials tonnage

Steel industry imposes special demands on bulk transport facilities. About four tons of raw materials and consumable items are required to produce one ton of steel. The anticipated traffic tonnage for operation of integrated steel works and the other selected industries have been worked out in Appendix 10-2 and summarised in Table 10-4. Residual products like slag, muck, used sand, debris, etc have not been taken into account in these calculations as waste materials are generally dumped or

10 - Development of steel industry (cont'd)

Table 10-9

ANTICIPATED VOLUME OF GOODS TRAFFIC

(All figures are in thousand tons)

Product	1977		1982	
	Production target	Approximate traffic volume	Production target	Approximate traffic volume
Tonnage steel: ore-based	3 000	15 000	5 000	25 000
Tonnage steel: electric furnace	150	316	300	651
Alloy steel	60	[illegible]	100	280
Steel castings	7.5	34	12	55
Ferro-silicon - 45% grade	28	90	28	90
Ferro-manganese - 75% grade	38	173	55	251
Low-carbon ferro-chrome	10	85	10	85
High-carbon ferro-chrome	4.5	21	4.5	21
Malleable iron castings	10	37	18	66
Grey iron castings	80	267	150	[illegible]
Sponge iron (by HyL process)	[illegible]	[illegible]	300	[illegible]
Refractory firebricks	25	66	75	[illegible]
Manufactured items of tonnage steels	2 500	1 250	4 200	2 100
Manufactured items of alloy steels	60	40	100	80
Rolled/processed products from steel semis	600	[illegible]	1 020	[illegible]
Total		[illegible]		[illegible]
		Say 18 million tons		31 million tons

9 - Analysis of shortfall (cont'd)

1968 are given below:

Type of mill	Tube size range	Capacity tons	Production 1968 tons
Small mill	150 mm - 400 mm	120 000	60 000
Big mill	450 mm - 1200 mm	240 000	90 000
	Total	360 000	150 000

The capacity planned to be installed by 1975 is 450,000 tons per year.

IMDBI pipe mill

In addition to the Ahwaz pipe mill, IMDBI is contemplating to install a pipe plant of 40,000 tons per year capacity by 1975. The pipes will be straight welded and in the size range 25 mm to 150 mm diameter.

Strip and skelp mill

IMDBI is also installing a narrow strip/skelp mill of capacity 200,000 tons per year. It is expected that the mill will commence production by end 1971 and full production will be achieved by 1973.

Sepanta Industrial & Commercial Co

Sepanta Industrial and Commercial Co produces galvanised sheets and welded tubes. The current galvanised sheet capacity of 15,000 tons is being increased. The production of welded tubes is 35,000 tons.

10 - Development of steel industry (cont'd)

disposed off within short haulage distances (though in a few exceptional cases, items like blast furnace slag when used for making by-products like cement may be required to be hauled over a long distance). It will be seen from Table 10-9 that development of the steel industry in Iran will generate goods traffic of approximately 18 million tons by 1977 and 31 million tons by 1982. The integrated steelworks alone will contribute about 86 per cent of this traffic volume.

Transport requirements

The requirements of railway wagons and trucks/tractor-trailer combination to handle goods traffic of this magnitude have been worked out in Table 10-10.

Table 10-10

REQUIREMENT OF RAIL AND ROAD CARRIERS

Traffic particulars	Probable allocation	Anticipated requirement by 1977	1982
By railways			
Volume of traffic	About 70 per cent	13 million tons	22 million tons
Movement of traffic	Average lead of	4 550 million ton-kms	7 700 million ton-kms
Four-wheeler 20-ton pay load wagons in service	Average movement of 500 000 ton-kms of payload per year	9 100 Nos.	15 400 Nos.
By road			
Volume of traffic	About 30 per cent	5 million tons	9 million tons
Movement of traffic	Average lead of 200 kms	1 000 million ton-kms	1 800 million ton-kms
Trucks and tractor-trailer combinations (average payload of 10 tons at 75 per cent load factor) in service	Average movement of 400 000 ton-kms of payload per year	2 500 Nos.	4 500 Nos.

10 - Development of steel industry (cont'd)

Development of transport

Arrangements will have to be made for the procurement of fleets of railway wagons and truck/tractor-trailer combinations and also suitable construction programmes will have to be initiated after integrating the above requirements with those of other sectors of the country's economy for the development of following works:

Railways:

- Rolling stock, e.g. locomotives, general-purpose freight wagons, special duty wagons etc.
- Line capacity works such as dieselisation and electrification, construction of new railway lines, marshalling yards, crossing facilities, loops and track renewals.
- Miscellaneous works like signalling and safety works, bridges, workshops etc.

Roads:

- Vehicles, e.g. trucks, tractor-trailers, spare parts.
- Carriageways - Construction, widening, stabilisation and surfacing.
- Connecting links like bridges, culverts, manufacturing and repair works.

Utilities

Requirements

Tentative estimates of the requirements of major utilities for the development of steel industry in Iran are given in Table 10-11.

Water resources are not abundant in Iran and therefore great care has to be taken in selecting the location of new plants as well as in the design of the

Table 10-11

ESTIMATED REQUIREMENTS OF UTILI[illegible]

Utility	Year	Unit	Tonnage steel: gas based	Tonnage steel: electric furnace	Alloy steel
Water	1977	cu m/day	180 000	3 000	8 500
	1980	cu m/day	281 000	4 000	13 500
[illegible]	1977	cu m/day	1 894 000	50 000	[illegible]
	1980	cu m/day	3 088 000	108 000	200 [illegible]
Fuel oil	1977	tons/year	-	-	-
	1980	tons/year	-	-	-
High purity i.e. 99.5 min oxygen	1977	tons/day	900 a/	[illegible]	[illegible]
	1980	tons/day	1 [illegible] b/	11	7
Low purity i.e. 85/95 oxygen	1977	tons/day	650	-	-
	1980	tons/day	1 000	-	-
Acetylene	1977	cu m/day	800	35	[illegible] c/
	1980	cu m/day	1 500	70	[illegible]
Compressed air	1977	cu m/hour	50 000	1 500	1 [illegible]
	1980	cu m/hour	63 000	[illegible]	[illegible]

a/ Includes [illegible] million cu m/day for production of [illegible] tons/day of sponge iron
b/ Includes [illegible] million cu m/day for production of [illegible] tons/day of sponge iron
c/ The [illegible] daily demand is likely to be [illegible] per cent higher than these figures of average daily [illegible]
d/ Includes provision for installation of an in-line scarfing machine in the blooming mill at a future [illegible]

SECTION 1 I

Table 10-11

Table 10-11

.QUIREMENTS OF UTILITIES

	[illegible]	[illegible]	[illegible]			Malleable iron [illegible]	[illegible]	[illegible]
			[illegible]	[illegible]	[illegible]			
	8 [illegible]	[illegible]	1 1[illegible]	-	[illegible]40	400	144	[illegible] [illegible]10
	13 [illegible]	[illegible]	1 1[illegible]	-	[illegible]40	7[illegible]0	[illegible]40	[illegible] 14[illegible]
	[illegible] 000	-	-	-	-	-	-	[illegible] [illegible] 000
	[illegible] 000	-	-	-	-	-	-	3 [illegible] 000
	-	1 [illegible]	-	-	7 [illegible]	[illegible]	[illegible]10	9 [illegible]10
	-	1 [illegible]	-	-	7 [illegible]00	[illegible]	[illegible]	10 [illegible]
	[illegible]	0.3	-	-	-	-	-	[illegible]
	[illegible]	0.4	-	-	-	-	-	1 [illegible]
	-	-	-	-	-	-	-	[illegible]
	-	-	-	-	-	-	-	1 [illegible]
	[illegible]	[illegible]	-	-	-	-	-	1 [illegible]
	[illegible]	[illegible]	-	-	-	-	-	1 [illegible]
	1 [illegible]	[illegible]	-	-	[illegible] [illegible]	[illegible]	-	[illegible] [illegible]
	[illegible] [illegible]	[illegible]	-	-	[illegible] [illegible]	[illegible]	-	[illegible] [illegible]

[illegible]

[illegible]

SECTION 2

10 - Development of steel industry (cont'd)

plant water system to minimise make-up water requirements.

At the same time major emphasis must be placed on control of environmental pollution.

Development [illegible]

Measures to be adopted for meeting these requirements of utilities may be on the lines indicated in Table 10-12.

Table 10-12

SUGGESTED MEASURES FOR WATER AND OXYGEN SUPPLY

Steel Industry	Arrangement for	
	Water	Oxygen
1. Tonnage steel - ore-based	Impounding water in a reservoir by constructing a dam across a river at a suitable site.	Installation of tonnage oxygen plant at works
2. Tonnage steel - electric furnace	Construction of an intake well and a pumphouse in a nearby river or getting supply from nearby water mains or tubewells	Installation of a liquid oxygen plant at works
3. Alloy steel	-do-	-do-
4. Steel and malleable iron castings	Extension of nearby water mains or boring tubewells and installing a water softening plant	Installation of liquid oxygen plants in foundries or getting bottled supply depending upon the relative economics
5. Ferro-silicon and ferro-manganese	Construction of an intake well and a pumphouse in a nearby river	-
6. Ferro-chrome	Boring tubewell and installation of a water softening plant	-
7. Iron castings	Drawing water from existing nearby mains	-

10 - Development of steel industry (cont'd)

The acetylene required in integrated steelworks mainly for the repair and maintenance shops and rolling mills can be generated at the works from calcium carbide. However, for many uses liquified petroleum gas, which will be readily available in Iran, can be substituted for acetylene in the approximate volumetric ratio of 1:7.5. It is customary to install working and standby air compressors in all industrial undertakings where compressed air is required. The fuel oil will have to be transported mostly in road tankers as the quantities are small. The natural gas supplies can be drawn from the network of natural gas pipelines under construction in the country and hence only extension or laying of branch pipelines will be necessary.

The requirements of water, fuel, oil, natural gas etc, for steel processing industries are comparatively small and generally do not call for the development of major infrastructure works. The large steel processing establishments may require substantial quantities of oxygen and acetylene, which can be met by installation of liquid oxygen plants and acetylene generators. Two or three tonnage oxygen plants can be set up at strategic locations to meet the requirements of liquid and bottled oxygen of these industries.

10 - Development of steel industry (cont'd)

Metal production industries

Manpower requirements

The complicated technology and capital-intensive character of the modern steel industry calls for a strong cadre of trained and resourceful technical and managerial personnel to run it. The manpower requirements for development of the tonnage and alloy steel industry (including ferro-alloys) in Iran are broadly projected in Appendix 10-3 and summarised in Table 10-13.

Table 10-13

ESTIMATE OF MANPOWER FOR DEVELOPMENT OF THE STEEL INDUSTRY

[illegible]	[illegible]		[illegible]	
	Number	Per cent	Number	Per cent
1. High-level personnel:				
Managers	[illegible]	0.50	[illegible]	0.40
Engineers	[illegible]	[illegible]	[illegible]	[illegible]
2. Medium-level personnel:				
Foremen	[illegible]	[illegible]	[illegible]	[illegible]
Technicians	1 704	9.40	[illegible]	9.20
3. Administrative staff and workers:				
Administrative staff	[illegible]	4.10	[illegible]	[illegible]
Workers:				
Skilled	[illegible]	[illegible]	10 [illegible]	[illegible]
Semi-skilled	[illegible]	[illegible]	11 [illegible]	[illegible]
Unskilled	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]

10 - Development of steel industry (cont'd)

Steel-based secondary and consuming industries

The major demand for manpower in terms of numbers will however arise in the manufacturing and repair industries consuming the steel produced in the above plants. According to an estimate of the United Nations,[1] initial industrialization requires approximately [illegible] to 10,000 persons per million inhabitants for building and metal products, machinery and tools and for the repair and maintenance of transport, agricultural, mining and industrial equipment. Assuming that steel consuming industries will account for approximately [illegible] per cent of the total product activities in [illegible], the requirements of manpower for steel processing industries are estimated as shown in Table 10-[illegible].

Table [illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
Manpower requirements:			
1. [illegible] personnel	[illegible]	[illegible]	[illegible]
2. [illegible] personnel	[illegible]	[illegible]	[illegible]
3. Administrative staff and workers	[illegible]	[illegible]	[illegible]
Total		[illegible]	[illegible]

[1] Estimation of managerial and technical personnel requirements in selected industries : [illegible] Industry/[illegible] ... United Nations, New York, September [illegible].

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1. [illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2. [illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3. [illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]

9 - Analysis of shortfall (cont'd)

The availability of different steel products from primary as well as secondary producers is summarised in Table 9-1.

Demand, availability and shortfalls of tonnage steel

By comparing the availability of each category of product (based on first stage of Isfahan steel plant) with the total demand for the same, the shortfall or surplus in each category is derived. The probable shortfalls in the final years of the Fourth, Fifth and Sixth five year plan periods are examined below.

It must be emphasised that if there is delay in the completion of the Isfahan and other steel projects, or if due to operating difficulties the production does not climb rapidly as envisaged, then the availability of steel would be reduced, and the shortfalls estimated here would greatly increase. These large shortfalls would, in turn, act as a brake on the growth of the economy.

[illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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1. [illegible]
2. [illegible]

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3. [illegible]
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7. [illegible]
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11. [illegible]
12. [illegible]
13. [illegible]
14. [illegible]

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[illegible]

[illegible]

[illegible]

Table 10.17 Table 10.17

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

SECTION [illegible]

Table 9-1

AVAILABILITY OF TONNAGE STEEL

(in thousand tons)

Category		Isfahan steel plant a/ 1972	1977	1982	Iranian Rolling Mills Co 1972	1977	1982	Other plants f/ 1972	1977	1982
Structurals										
Beams	..	-	234 000	234 000	-	-	-	-	-	-
Channels	..	-	11 000	11 000	-	-	-	-	-	-
Angles	..	-	35 000	35 000	20 000	20 000	20 000	-	-	-
Tees	..	-	-	-	5 000	5 000	5 000	-	-	-
Sub-total	..	-	280 000	280 000	25 000	25 000	25 000	-	-	-
Flat products										
Plates	..	-	-	-	-	-	-	-	-	-
Cold rolled sheets/strips		-	-	-	-	-	-	-	-	-
Hot rolled sheets/strips		-	5 000	5 000	-	-	-	100 000 f/	200 000 g/	200 000 g/
Tinplate	..	-	-	-	-	-	-	-	-	-
Galvanised	..	-	-	-	-	-	-	15 000	15 000	15 000
Sub-total	..	-	5 000	5 000	-	-	-	115 000	115 000	115 000
Others										
Bars, rods and flats b/		-	140 000	140 000	210 000	260 000 d/	260 000 d/	-	-	-
Wires	..	-	-	-	15 000	15 000	15 000	-	-	-
Pipes and tubes c/	..	-	-	-	-	-	-	345 000 h/	453 000 h/	453 000 h/
Sub-total	..	-	140 000	140 000	225 000	275 000	275 000	345 000	453 000	453 000
Rails	..	-	5 000	5 000	-	-	-	-	-	-
Total	..	-	430 000	430 000	250 000	300 000	300 000	460 000	668 000	[illegible]
Billets	..	-	70 000	70 000	-	150 000 e/	150 000	-	-	-

a/ The product-mix given in Soviet DPR is assumed to be achieved by 1977. Since the plant is expected to commence [illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1 [illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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SECTION 1

SECTION 2

SECTION 3

SECTION 1

SECTION 2

SECTION 3

					-	-	-	345 000	453 000	453 000
Sub-total	..	-	140 000	140 000	225 000	275 000	375 000	345 000	453 000	453 000
Rails	..	-	5 000	5 000	-	-	-	-	-	-
Total	..	-	430 000	430 000	250 000	300 000	300 000	460 000	668 000	[illegible]
Billets	..	-	70 000	70 000	-	150 000 e/	150 000	-	-	-

a/ The product-mix given in Soviet DPR is assumed to be achieved by 1977. Since the plant is expected to commence operation only in 1972, its production during the year will be negligible. For 1982, the same production as in 1977 has been taken, though it is planned to more than double the capacity. This has been done in order to determine the unsatisfied demand in each category after the first phase so that the shortfalls, on the basis of which the product-mix for expansion is to be decided, could be ascertained.

b/ Flats comprise 10,000 tons of 20 mm to 125 mm wide x 4 mm to 12 mm thick flat bars and 10,000 tons of 130 mm to 200 mm wide x 8 mm to 20 mm thick flat bars included in the product-mix.

c/ Pipes and tubes other than seamless tubes.

d/ Out of the total capacity of 65,000 tons of the first mill 40,000 tons are bars, while in the second mill bars account for the entire capacity of 85,000 tons. These when added to the third mill capacity of 150,000 tons of bars and rods, give a total capacity of 275,000 tons of bars and rods. Out of this, 15,000 tons of rods will be utilised for wire drawing, leaving a balance of 260,000 tons of bars and rods.

e/ An expansion programme for the production of continuous cast billets is now under active consideration. It is expected that installation of plant will be completed only by 1972. Therefore, there will be little or no production in 1972 but full capacity may be achieved in 1977.

f/ Other plants include Ahwaz Pipe Mill, IMDBI pipe mill (Ahwaz Pipe and Rolling Mill Company) and Sepanta Industrial and Commercial Co.

g/ Production to the extent of 50 per cent of capacity is expected from narrow strip/skelp mill of IMDBI pipe plant in 1972. But in 1977 and 1982 full production of 200,000 tons has been taken into consideration.

h/ Present installed capacity of Ahwaz pipe plant is 360,000 tons and expansion of 450,000 tons capacity is expected to be completed by 1975. In addition to Ahwaz pipe plant, another pipe plant of 40,000 tons capacity, [illegible] by IMDBI, is expected to be commissioned by 1975. Sepanta Industrial & Commercial Co is producing at present 35,000 tons of welded pipes and tubes. Assuming 85 per cent utilisation of total installed capacity of Ahwaz pipe plant and IMDBI pipe plant taken together, the availability from these plants will be 310,000 tons in 1972 and 418,000 tons in 1977. Adding to these 35,000 tons of pipes from Sepanta Industrial & Commercial Co, the total availability will be 345,000 tons in 1972 and 453,000 tons in 1982.

SECTION 2

SECTION 1

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SECTION 2

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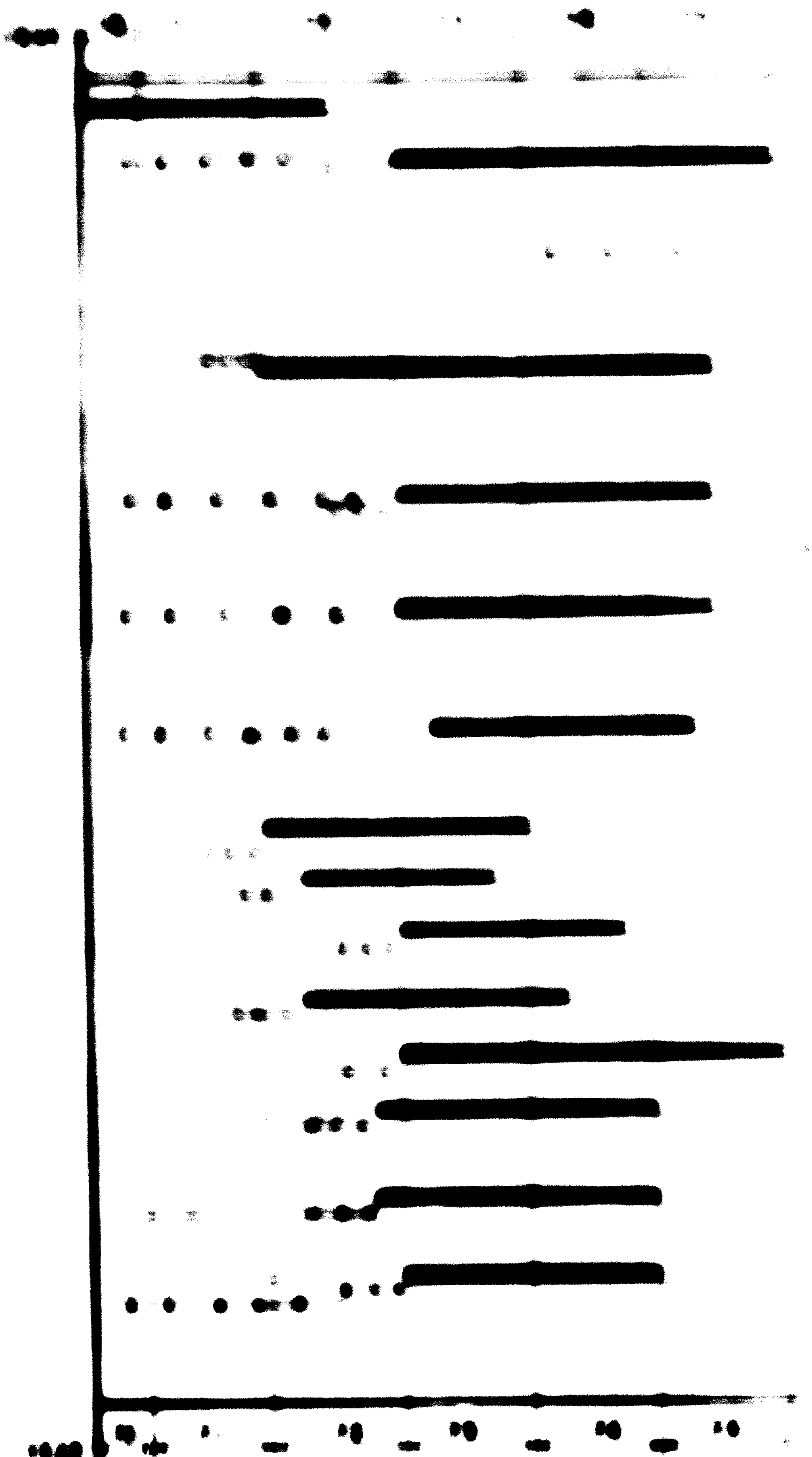
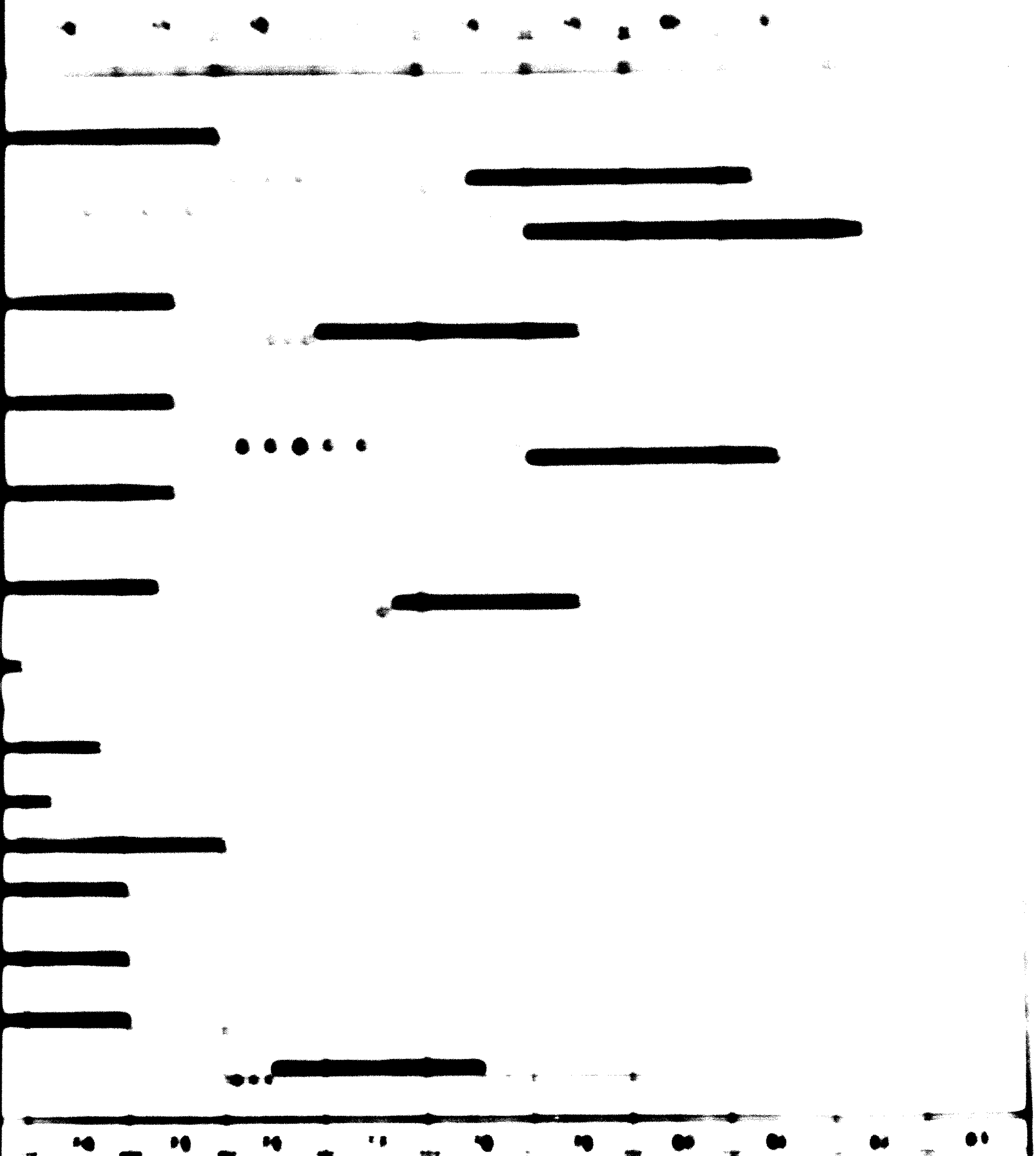


FIG 10-2. TENTATIVE TIME SCHEDULE

SECTION 1



THE SCHEDULE FOR DEVELOPMENT OF STEEL AND OTHER RELATED INDUSTRIES

SECTION 2

TEEL AND OTHER RELATED INDUSTRIES

SECTION 3

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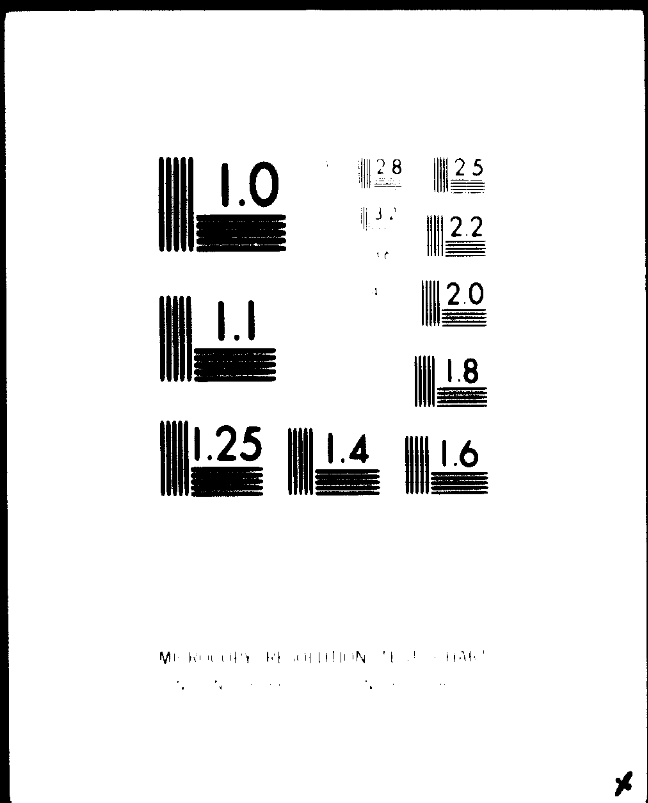

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10 - Development of steel industry (cont'd)

Parts to be manufactured (continued)	:	Engineering castings for internal combustion engines such as crank-shaft, sprocket, rocker arms and for textile machinery e.g. beam flanges, treadle bowls, treadle bowl pins, picking knobs, heaters, warping beams, crank arms etc. Railway wagon parts e.g. brake beam parts and axle roller bearing adapters, signal fittings, carriage and locomotive fittings; expansion joints for bridges. Parts of industrial plant and equipment e.g. gear reducers and brakes and saddle bearing assembly for oil field equipment, roller guide stands for passenger lifts, axle housings for fortlift trucks, chain links of conveyors. Parts of domestic and industrial appliances such as legs, brackets, gears, handles, clamps, hinges, levers, bearing housings and couplings. Hardware parts for electrical transmission and distribution, fence fittings, boat fittings, vices, tool holders etc. Fittings for pipes and electrical conduits and hand wheels for valves.
Maximum unit weight of castings	:	20 kg

10 - Development of steel industry (cont'd)

3. Major production and maintenance departments

1. Pattern making
2. Sand mixing, reconditioning and preparation
3. Moulding and core-making
4. Melting and/or duplexing and pouring
5. Annealing furnaces
6. Shotblasting and fettling with grinders
7. Galvanising of pipe fittings
8. Adjustment of pipe fittings on eccentric presses or internal adjustment machines, thread cutting and hydraulic pressure testing
9. Machining of castings in some cases
10. Testing laboratory.

10 - Development of steel industry (cont'd)

FERRO-SILICON AND FERRO-MANGANESE PLANT

1. Demand for ferro-silicon and ferro-manganese

The future estimated requirements of ferro-silicon and ferro-manganese for home consumption in Iran are given in Tables 10-23 and 10-24 respectively.

Table 10-23

ESTIMATED REQUIREMENTS OF FERRO-SILICON (75% GRADE)

End user industry	Specific consumption rate of Fe-Si kg/ton	1977 Probable production tons	1977 Likely requirements of Fe-Si tons	1982 Probable production tons	1982 Likely requirements of Fe-Si tons
Tonnage steel - ore based	3	3 000 000	9 000	5 000 000	15 000
Tonnage steel - electric furnace	5	150 000	750	300 000	1 500
Alloy steel	9	60 000	540	100 000	900
Silicon steel	40	-	-	6 000	240
Steel castings	13 a/	7 500	100	12 000	160
Malleable iron castings	8	10 000	80	18 000	144
Grey iron castings	7	90 000	650	150 000	1 050
			11 100		18 994

a/ equivalent to consumption rate of 7 kg/ton of liquid steel

10 - Development of steel industry (cont'd)

Table 10-24

ESTIMATED REQUIREMENTS OF FERRO-MANGANESE (75% GRADE)

End user industry	Specific consumption rate of Fe-Mn kg/ton	1977 Probable production tons	1977 Likely requirements of Fe-Mn tons	1982 Probable production tons	1982 Likely requirements of Fe-Mn tons
Tonnage steel - ore based	10	3 000 000	30 000	5 000 000	50 000
Tonnage steel - electric furnace	8	150 000	1 200	300 000	2 400
Alloy steels	10	60 000	600	100 000	1 000
Malleable castings	12	10 000	120	18 000	216
Steel castings	18 a/	7 500	140	12 000	220
Total			32 040		53 836

a/ equivalent to consumption rate of 10 kg/ton of liquid steel

Besides there is substantial demand for export of ferro-silicon in the international market.

10 - Development of steel industry (cont'd)

2. Suggested product-mix

Ferro-silicon

17,000 tons/year of 75 per cent grade
or
28,000 tons/year of 45 per cent grade
or
equivalent of various grades

Ferro-manganese

38,000 tons/year of standard grade with

74 to 78 per cent manganese

3. Major production sections

1. Crushing and screening facilities for sizing quartzite and manganese ore

2. Smelting furnaces for ferro-silicon and ferro-manganese

3. Tapping and casting yard

4. Testing laboratory

SPONGE IRON PLANT

1. Demand for sponge iron

The three ferrous materials used for steelmaking are:

i) Hot metal/pig iron produced in blast furnaces or electric smelters

ii) Scrap steel and, to some extent, cast iron scrap generated during the three stages of the life of steel viz. making/shaping, processing and obsolescence, and

iii) Sponge iron produced by direct reduction of iron ore with gaseous or solid reductants

Non-availability of metallurgical grade coking coal with optimum characteristics in the proximity of iron ores generally raises the cost of production of pig iron. The availability of steelmelting scrap suitable for steelmaking is limited in countries with low level of per capita steel consumption. Under such conditions sponge iron could become a competitive raw material in countries like Iran where cheap fuels like natural gas or petroleum naptha (from which reducing gas can be generated by steam reforming) are available in abundance and high grade iron ore is available indigenously or can be readily imported. The economic conditions and natural gas resources of Iran can therefore be considered to be favourable for the production of sponge iron.

The national scrap balance projected for the years 1977 and 1982 as given in Table 10-25 shows scrap deficits of the order of 209,000 tons and 864,000 tons respectively for these two years.

10 - Development of steel industry (cont'd)

Table 10-25

PROJECTED SCRAP BALANCE - 1977 AND 1982

Type of scrap	Basis 1977	Basis 1982	Estimated scrap quantity 1977 tons	Estimated scrap quantity 1982 tons
Scrap availability				
Process scrap as related to finished steel consumption a/	5% of 2.5 million tons	6% of 4.2 million tons	125 000	252 000
Capital scrap as related to process scrap b/	30% of process scrap		37 500	75 600
	Total scrap arisings		162 500	327 600
	Total scrap availability (at 80% of total arisings)		130 000	264 000
	Availability of melting scrap c/ (at 85% of total availability)		110 500	224 500
		Say	111 000	225 000
Scrap demand				
As per table 10-4 ...	...	...	320 000	589 000
Scrap shortfall ...	...	...	209 000	364 000

a/ The current process scrap generation is estimated to be about 3 per cent of the finished steel consumption

b/ Based on the proportion currently obtaining in India

c/ Assuming diversion of the balance scrap for re-rollable and industrial uses

10 - Development of steel industry (cont'd)

The scrap deficit will have to be met by importing steel scrap. An alternative and better way from the point of view Iran's national economy to meet this deficit would be to set up a sponge iron plant in Iran based on HyL process in use in Mexico. In this process natural gas is used as reductant as well as fuel to produce sponge iron which can conveniently replace about 50 to 60 per cent of the scrap requirement for electric steelmaking.

2. Suggested manufacturing programme.

Two units, each of capacity 150 tons per day of sponge iron (about 80 per cent iron content)

Production capacity - 100,000 tons of sponge iron per year

Sponge iron quality - 85 per cent metallisation

$$\text{metallisation} = \frac{\text{Non-oxide iron i.e. Fe+Fe in } Fe_3C}{\text{Total iron i.e. Fe+Fe in FeO}, 950 \text{ and } Fe_3C}$$

Total Fe: 86 to 88 per cent

Carbon : 1.5 to 2.5 per cent

Maximum gangue content: 7 per cent

3. Raw material requirements

Lump iron ore/pellets:

Quantity - 140,700 tons per year with 65 per cent Fe content

Quality - It is generally necessary to employ high grade iron ore (with 65 to 67 per cent Fe), low in gangue - silica (SiO_2) plus alumina (Al_2O_3) not exceeding 6 per cent and phosphorus not exceeding 0.10 per cent. The ore should be lumpy ore within a restricted size range (hardened pellets would constitute an excellent raw material), should not decrepitate on heating and should have minerological and porosity characteristics condusive to good reducibility. The ore should preferably be hematite (Fe_2O_3). Mexican plant which has adopted HyL process on a large scale uses ore with an Fe content as low as 60 per cent and silica in the range of 6 to 9 per cent, while phosphorus content of 0.38 per cent in the Mexican ore has been accepted. However, sponge iron produced from iron ore of these specifications is reported to give rise to considerable slag volume at the steelmelting stage.

Size - Optimum -38 mm to +6 mm with -6 mm fines not exceeding 20 per cent.

The economies of using low grade Iranian ore after beneficiation and agglomeration, or pelletisation if need be, versus import of high grade low phosphorus iron ore from neighbouring locations like Goa (a major port on the west coast of India) cannot be evaluated at the present stage as sufficient data on physical characteristics, chemical composition, amenability to beneficaton, reducibility and the necessity of roasting the ore for sulphur removal of iron ore deposits in Iran are not available.

10 - Development of steel industry (cont'd)

Fuel and reductant gas

Type - Natural gas, liquified petroleum gas or naphtha reformed gas.

Quantity - 55.8 million NM^3 of natural gas with minimum heating value of 9,100 kilo-calories/cubic metre at pressure of 10.2 kg/cm^2.

Quality - Sulphur content of natural gas should be less than 11.4 $mgms/m^3$ (5 grains/1,000 cu ft).

4. Major production departments

Natural gas reformer furnaces

Water boiler, primary quench tower and gas pre-heater

Iron ore reduction retorts

Sponge iron collection, storage and transport.

Table 10-19

CATEGORYWISE AND SECTORWISE DE

Demand

Type of alloy steel	Transport equipment		Electrical equipment		Industrial and ag-cultural machine	
	tons	%	tons	%	tons	
By 1977						
Carbon constructional	4 695	4.70	60	0.10	1 260	1.
Alloy constructional	14 060	14.10	40	0.04	8 400	8.
Free cutting	1 930	1.90	50	0.06	1 120	1.
Spring	21 150	21.19	420	0.40	415	0.
Stainless steel	15	0.01	3 080	3.10	4 895	4.
Electrical sheets	-	-	6 610	6.60	-	
Tool steel	-	-	-	-	-	
Die blocks	-	-	-	-	-	
Total	41 850	41.90	10 260	10.30	16 090	16.
By 1982						
Carbon constructional	7 090	4.40	260	0.20	2 100	1.
Alloy constructional	24 520	15.28	120	0.10	12 140	7.
Free cutting	3 295	2.00	120	0.10	1 970	1.
Spring	34 015	21.20	730	0.50	1 310	0.
Stainless steel	30	0.02	5 510	3.30	7 500	4
Electrical sheets	-	-	9 040	5.60	-	
Tool steel	-	-	-	-	-	
Die blocks	-	-	-	-	-	
Total	68 950	42.90	15 780	9.80	25 020	15

SECTION 1

REFRACTORIES PLANT

1. Demand for refractories

A broad estimate of the operating requirements of refractories by the steel industry in Iran projected for the years 1977 and 1982 is presented in Table 10-26 and these requirements classified according to type are given in Table 10-27.

2. Indigenous capacity and shortfall

Dolomite bricks of both types, stabilised as well as non-stabilised, have to be manufactured in refractory plant or in proximity to the steel plant as they deteriorate rapidly during storage and transport. It is therefore presumed that the requirements of dolomite bricks will be catered to by captive refractory shops set up adjacent to the steel plants. The shortfall in the fireclay refractory supplies is anticipated to be of the order of 33,000 and 68,000 tons in 1977 and 1982 respectively assuming that captive capacity to manufacture about 25,000 tons of fireclay bricks per year is likely to be set up in the first stage of construction of the Isfahan Steel Plant.

3. Suggested product-mix

Type of refractory	Production tons/year
Blast furnaces and stoves lining and standard bricks	4 000
High-grog ladle lining	14 000
Stopper rod sleeves	3 600
Stoppers and nozzles	900
Special shapes and wedges for coke ovens, reheating furnaces etc	1 000
Mortars	1 500
Total	25 000

SECTION 1

Table 10-26

ESTIMATE OF OPERATIONAL REQUIREMENTS OF REFRACTORIES

Section of steel plant	Approximate life of refractories a/	Specific refractory consumption a/	1977 Steel production capacity	1977 Refractory requirement	1982 Steel production capacity	1982 Refractory requirement
Steelmelt shop						
a) LD convertors						
i) All tarbonded dolomite bricks or	250 to 270 heats with untempered bricks	8 kg/ingot ton	3 000	24 000	5 000	40 000
ii) Tarbonded dolomite brick lining with backing of chrome magnesite bricks	420 to 470 heats with tempered bricks					
b) Electric arc furnaces c/ silica bricks for roof	100 to 120 heats	6 to 7 kg per ingot ton	260	1 990	470	3 370
Magnesite and chrome magnesite bricks for sides	150 heats	6 to 7 kg per ingot ton		1 990		3 370
c) Pitside refractories						
i) Fireclay ladle bricks	15 to 20 heats	7 kg/ingot ton	3 260	22 990	5 470	38 600
ii) Sleeves, stoppers, nozzles and bottom pouring refractories	15 to 20 heats	2 kg/ingot ton		6 570		11 030
Iron making						
a) Blast furnace fireclay brick linings	5 to 10 years)	1.5 kg/ingot ton	equivalent ingots: 5 090	4 640	equivalent ingots: 5 150	7 730
b) Blast furnace stoves	10 to 15 years)					
i) Fireclay bricks and	)					
ii) High alumina or basic bricks	)					

Iron making						
a) Blast furnace fireclay brick linings	5 to 10 years	1.5 kg/ingot ton	equivalent ingots: 5 090	4 640	equivalent ingots: 5 150	7 730
b) Blast furnace stoves i) Fireclay bricks and ii) High alumina or basic bricks	10 to 15 years					
c) Blast furnace ladles	60 to 80 heats					
Casting/rolling						
a) Continuous casting plant						
i) Fireclay bricks for tundishes	8 to 10 casts	5 kg/ton of liquid steel	3 150	15 750	5 300	26 500
ii) Zircon bricks for tundish nozzles	One cast	0.15 kg/ton of liquid steel		470		800
b) Soaking pit						
i) Insulating firebricks	2 to 2.5 years	4 kg/ton of finished steel	finished steel: 3 550	14 000	finished steel: 4 380	17 520
ii) Fireclay bricks						
iii) Basic or high alumina bricks						
c) Reheating and annealing furnaces						
i) Insulating firebricks						
ii) Fireclay bricks						
Total				92 400		148 920

a/ Based on the current practice and operating efficiency in highly industrialised countries with refractory bricks of first rate quality

b/ Silica bricks required for coke ovens are not considered as their relining is usually done at the time of interval of 25 years

c/ Includes requirement for malleable iron castings

Table 10-26

SECTION 1

Table 10-27

REQUIREMENT OF REFRACTORIES BY TYPES

	Estimated requirements of refractories 1977 tons	1982 tons
1. Fireclay		
i) Ladle bricks	22 990	38 600
ii) Tundish bricks	15 750	26 500
iii) Blast furnace and stove linings @ 80% of total	3 710	6 180
iv) Soaking pit, reheating and annealing furnace bricks @ 62.5% of total ..	8 750	10 930
v) Sleeves, stoppers, nozzles and bottom-pouring refractories	6 570	11 030
	57 770	93 240
2. Tarbonded dolomite		
LD converters	24 000	40 000
3. Basic		
Magnesite and chrome-magnesite bricks ..		
i) Electric arc furnaces	1 990	3 370
ii) Blast furnace stoves @ 10% of total and finishing sections like soaking pit, reheating and annealing furnaces @ 95% of total	1 790	2 420
	3 780	5 790
4. Silica		
Electric furnace roof	1 990	3 370
5. High-alumina bricks		
i) Blast furnace stoves @ 10% of total and finishing sections like soaking pit,		

finishing sections like soaking pit, reheating and annealing furnaces @ 95% of total	.. ..	1 790	2 420
		3 780	5 790
4. **Silica**			
Electric furnace roof	... ..	1 990	3 370
5. **High-alumina bricks**			
i) Blast furnace stoves @ 10% of total and finishing sections like soaking pit, reheating and annealing furnaces @ 9.5% of total	.. ..	1 790	2 420
6. **Zircon**			
Tundish nozzles	.. ..	470	800
7. **Insulating firebricks**			
Soaking pits, reheating and annealing furnaces @ approx. 19% of total	.. ..	2 600	3 300
Total		92 400	148 920

Table 10-27

SECTION 2

10 - Development of steel industry (cont'd)

4. Major production and maintenance departments

1. Calcining non-plastic clays in kilns
2. Mill house for crushing and grinding as well as screening and grading of clays
3. Mixer bay
4. Press bay
5. Dryers
6. Kilns for burning
7. Testing laboratory

10 - Development of steel industry (cont'd)

FABRICATION SHOP FOR CHEMICAL PLANT AND REFINERY EQUIPMENT

1. Demand for chemical equipment fabricated from tonnage steel

The estimated demand for fabricated steel equipment in Iran is shown in Table 10-28.

Table 10-28

ESTIMATED DEMAND FOR CHEMICAL EQUIPMENT MADE OF TONNAGE STEEL

Year		Targets & investment on chemical equipment and machinery			Demand for fabricated tonnage steel equipment		
		Sugar a/ machinery million Rials	Cement b/ machinery million Rials	Total million Rials	Sugar & c/ cement machinery tons	Other d/ chemical equipment tons	Total tons
1972	..	225	460	685	1 137	5 400	6 537
1977	..	225	460	685	1 137	11 520	12 657
1982	..	360	735	1 095	1 825	18 000	19 825

a/ Assuming 75 per cent of the total plant cost as the cost of equipment and machinery.

b/ Assuming 70 per cent of the total plant cost as the cost of equipment and machinery.

c/ Reckoned at 1.66 ton per million Rials of investment in sugar and cement machinery as well as chemical equipment as under:

i) Cost of fabricated equipment as installed excluding bought out items like pumps, compressors, valves, blowers, pipes and fittings, instruments etc. = 37 per cent of the machinery cost

ii) Cost of fabricated equipment as delivered. = 68 per cent of (i)

iii) Ratio of tonnage steel and alloy and stainless steel chemical equipment. = 4:1 by weight or 1:1 by value

iv) Freight and insurance cost on steel equipment. = 4 per cent of ex-works price

v) Average ex-works price of tonnage steel equipment. = 60,000 Rials/ton

vi) About 20 per cent of tonnage steel equipment will continue to be imported.

Thus, weight of fabricated equipment per million Rials of machinery and equipment $= \frac{0.37 \times 0.68 \times 0.5 \times 0.8 \times 1{,}000{,}000}{1.04 \times 60{,}000} = 1.66$ tons.

d/ Assuming (i) 50 per cent of the tonnage requirements indicated by the Research Centre, Ministry of Economy, Imperial Government of Iran consist of plate & vessel work (ii) 20 per cent of the equipment will continue to be imported (iii) 10 per cent deduction for wastage of materials.

10 - Development of steel industry (cont'd)

Bulk storage tanks

The requirements of bulk storage tanks for petroleum and other uses are estimated at 8,200 tons and 9,300 tons per year by 1977 and 1982 respectively as shown in Table 10-29.

Table 10-29

ESTIMATED REQUIREMENTS OF BULK STORAGE TANKS

Items	Demand for finished bulk storage tanks		
	1972 tons	1977 tons	1982 tons
1. "Tank farms" for crude, intermediate and finished products in petroleum refineries a/	5 200	5 200	5 200
2. Gasholders b/	1 000	1 350	2 270
3. Tanks for storage of miscellaneous fluids other than water c/	1 550	1 640	1 870
Total	7 750	8 190	9 340

a/ Assuming that the National Iranian Oil Company sets up one refinery of 4.5 million ton throughout capacity every three years with 15,600 tons of tanks for storage of crude oil and intermediate and finished products.

b/ Based on the requirements in 1972 of steel for gasholders indicated by the National Iranian Gas Company as 600 tons (including 10 per cent as wastage), their requirements being 55 per cent of the total gasholder requirements for Iran, and projections of demand for subsequent years at 10 per cent compound rate of growth per year.

c/ At 25 per cent of the tonnages in 1 and 2.

Heavy plate and vessel works

The aggregate requirements of reactors, towers and other heavy plate and vessel works have been estimated in the steel demand study to be of the order of 3,000, 3,300, and

10 - Development of steel industry (cont'd)

4,000 tons in the years 1972, 1977 and 1982 respectively. Eighty per cent of these tonnage steel equipment by weight can be anticipated to be fabricated in Iran.

Steelworks equipment

The platework involved in the construction of a 2,000 tons/day capacity blast furnace (with average quality of raw materials burden) is about 2,000 tons as under:

Component	Finished platework for 2,000 tons/day blast furnace unit tons
1. Blast furnace proper	400
2. Stoves ..	400
3. Gas cleaning plant	400
4. Pipeline and ducting	[illegible] a/
Total	[illegible]

a/ Includes about 300 tons of simple pipework which can be made in a pipe plant.

Assuming a modest rate of increase in the steelmaking capacity of Iran by 0.4 million ton every four years, the annual requirements of hot metal and pig iron for sale will increase by about 0.44 million tons in the corresponding period, which will necessitate addition of a 2,000 tons/day blast furnace. Therefore, requirements of fabricated platework for blast furnaces alone will be about 500 tons per year initially.

Besides, fabricated platework is required for several other equipment in steelworks such as bins, ladles, tippler bodies etc. Items of such miscellaneous equipment which can be fabricated in Iran may be taken at 300 tons/year initially.

10 - Development of steel industry (cont'd)

Total requirement of fabricated equipment

The total requirement of fabricated equipment is given in Table 10-30.

Table 10-30

REQUIREMENT OF FABRICATED EQUIPMENT

Industry/End use	1972 tons	1977 tons	1982 tons
Chemical, cement and sugar industry	6 540	12 660	19 820
Bulk storate tanks	7 750	8 190	9 340
Refinery equipment, reactors, towers and other heavy plate and vessel works a/	1 600	2 640	3 680
Steelworks equipment b/	700	700	1 050
	[illegible]	[illegible]	[illegible]
Say	16 600	24 200	34 000

a/ It is assumed that 80 per cent of the total requirement for reactors, towers, etc may be fabricated in Iran

b/ The rate of manufacture of equipment within Iran for installation of additional capacity for this production of pig iron/hot metal is taken as increasing by 1.5 times during the five year period between 1977 and 1982.

2. Indigenous capacity and shortfall

Public sector: The proposed product-mix of the machine building plant at Arak provides for annual fabrication of 1,270 tons of storage tanks with spherical headers for water and oil, and 720 tons of equipment for sugar and cement plants.

Private sector: Cyrus Arjomand Works, Teheran have a well-equipped workshop and are engaged in the fabrication of steel structures as well as chemical equipment, storage tanks etc. Their current annual production,

AND SECTORWISE DEMAND FOR ALLOY STEELS

Demand by the consuming sector							
Industrial and agricultural machinery		Metal products		Provision for spares and maintenance, small-scale industries and stocks		Total	Proportion of overall total
tons	%	tons	%	tons	%	tons	%
1 260	1.30	1 450	1.50	1 685	1.50	9 150	9.10
8 400	8.40	10 315	10.30	5 325	5.26	38 140	38.10
1 120	1.10	334	0.30	836	0.94	4 270	4.30
415	0.40	-	-	5 085	5.11	27 070	27.10
4 895	4.90	461	0.50	1 269	1.19	9 720	9.70
-	-	-	-	460	0.50	7 070	7.10
-	-	-	-	-	-	4 000	4.00
-	-	-	-	-	-	500	0.50
16 090	16.10	12 560	12.60	19 160	19.10	99 920	100.00
2 100	1.30	2 555	1.60	3 225	1.90	15 230	9.40
12 140	7.60	13 030	8.10	10 480	6.42	60 290	37.50
1 970	1.20	480	0.30	1 555	1.00	7 420	4.60
1 310	0.80	20	0.01	9 165	5.59	45 240	28.10
7 500	4.70	945	0.59	2 085	1.59	16 070	10.20
-	-	-	-	1 330	0.90	10 370	6.50
-	-	-	-	-	-	5 040	3.10
-	-	-	-	-	-	840	0.60
25 020	15.60	17 030	10.60	33 720	21.10	160 500	100.00

SECTION 2

reported to be 5,000 to 6,000 tons per year including steel structures, is expected to be raised to 12,000 tons per year very shortly. However, about one-half of this production is estimated to be steel structures and 50 per cent f the balance water supply tanks etc. Hence, their capacity for other platework can be taken at about 3,000 tons per year.

Other manufacturers like (i) Stock Work Spour, Ahwaz, (ii) Chakosh Company, Teheran, (iii) Zigana Company, Teheran, (iv) Luleh Va Machine Sari Iran Company, Teheran, and (v) Azari Company, specialise in the fabrication of tanks for water supply schemes and small shop fabricated tanks for miscellaneous purposes only. Hence, their combined contrubition to the manufacture of platework under consideration is not likely to exceed 1000 tons per year.

Thus, shortfalls of the order of 18,200 tons and 28,000 tons per year are expected by 1977 and 1982 in the indigenous capacity for fabrication of tonnage steel equipment for sugar, cement and chemical industries as well as oil refineries and bulk storage tanks for petroleum oil, gas and processed consumer oil. It is possible that Iran may be able to develop an export market for about 1,000 tons of fabricated equipment to the two R.C.D. countries, Turkey and Pakistan.

10 - Development of steel industry (cont'd)

5. Suggested manufacturing programme

Production capacity : 10,000 tonnes per year of fabricated steel equipment, in two shift operation,

Equipment to be fabricated : Storage of equipment

Bulk storage installations like tanks, gas holders, pressure vessels, bins, tank cars etc.

: Reaction equipment

Reaction vessels, pressure reactors, catalytic reaction vessels or towers,

Process equipment

Distillation - Distillation columns, stills

Absorption and extraction - absorption columns, extractors.

Mechanical separation - cyclones, crystallizors.

Others - evaporators, driers.

: Heat transfer equipment

Condensers, heat exchangers, coolers, heaters, chimneys.

Steelworks equipment

Iron making - blast furnace components such as shells,gas and bustle pipes, blast mains,tuyers,dust catchers,stoves

Calcining - lime kilns,gas cleaning plant.

Cooking - coke ovens,quenching car bodies.

Material handling - ladles,transfer cars,dump cars,tippler bodies,bins, bunkers, hoppers

: Industrial services - ducting.

10 - Development of steel industry (cont'd)

4. Proposed product-mix

Group	Dimensions of the item	Output per year tons
High pressure vessels (pressure exceeding 30 kg/cm^2 or atmospheres)) Medium pressure vessels (pressure upto 30 kg/cm^2 or atmospheres)	Plate thickness : 20-40mm Vessel diameter: Upto 4 metres Weight : Upto 40 tons	1 000
Low pressure vessels (pressure slightly exceeding the atmospheric)	Plate thickness: Upto 20 mm Vessel diameter: Upto 4 metres Weight: Upto 40 tons	500
Single pass and multi-pass heat exchangers	Diameter of tubes / Maximum plate thickness: Upto 20 mm — 30 mm 20-40 mm — 50 mm 40-100 mm — 50 mm	500
Blast furnace components Steelworks material handling equipment	Plate thickness: Upto 50 mm Vessel diameter: 1.5 - 12mm Weight: Upto 800 tons	500
Bulk storage tanks and gas holders	Plate thickness -6-40 mm Vessel diameter -Upto 40 mm Weight - Upto 400 tons	7 500

5. Major production and maintenance departments

1. Metal making and preparation shop
2. Structural shop
3. Metal forming shop
4. Machine shop
5. Tube shop
6. Assembly shop
7. Heat treatment shop
8. Testing, inspection and painting bay
9. Smithy
10. Carpentry and template shop

10 - Development of steel industry (cont'd)

FABRICATION SHOP FOR HEAVY STRUCTURAL STEELWORK

1. Demand for heavy structural steelwork

The requirement of heavy structural steelwork (involving components with individual weights exceeding 4 tons or use of heavy rolled sections of section weight about 45 kg per metre) will normally amount to about 10 per cent of total structural steelwork requirements, and on this basis, heavy structural steelwork requirement is estimated to be approximately 42,800 and 45,800 tons per annum in 1977 and 1982 respectively, as worked out in Table 10-31.

Table 10-31

ESTIMATED REQUIREMENT OF STRUCTURALS

Sector of constructional activity	Requirement of structurals as per this study			
	1977		1982	
	Quantity tons	Proportion per cent	Quantity tons	Proportion per cent
Social services	218 630	53.90	129 000	30.25
Large and medium industries	83 700	21.00	140 730	32.90
Power supply - stations	23 100	5.50	30 300	7.10
- transmission towers	13 250	3.30	25 400	5.90
Irrigation	17 600	4.40	25 000	5.80
Ports and harbours	13 630	3.40	26 100	6.10
Agricultural & allied activities	8 900	2.30	12 670	2.90
Oil and gas	8 000	2.00	19 900	4.65
Telecommunications	7 770	1.90	11 070	2.65
Roads and bridges	4 900	1.20	6 800	1.60
Airports	340	0.10	490	0.15
	399 820	100.00	427 460	100.00
15% addition for gussets, round bars etc	60 000		64 500	
	459 820		491 960	
7% deduction for balance pieces, scrap generation, irrecoverable losses, etc	32 200		34 400	
Total requirement of finished structures	427 620		457 560	
Requirement of heavy structures @ 10% per cent a/ of the total requirement of structures	42 760		45 760	

a/ The current corresponding proportion in India is estimated as 15 per cent

Of this, the annual demand for heavy steel structures for metallurgical industries and power generation is expected to be of the order of 24,000 tons and for heavy chemical industries about 7,000 tons, as estimated in Tables 10-32 and 10-33.

Table 10-32

REQUIREMENTS OF HEAVY STEEL STRUCTURES FOR METALLURGICAL INDUSTRIES AND POWER GENERATION

Industry	Reference unit: annual capacity of plant	Average annual addition a/ in terms of unit capacity	Norm for structural steelwork quantity/ unit capacity tons	Estimated demand for structural steelwork tons/year
Metallurgical:				
Iron and steel	million ingot tons	0.375	52 000 b/	19 500
Alloy and tool steel (non-flat products)	60 000 finished tons	0.2	12 000	2 400
Ferro-silicon	17 000 tons	0.125	1 900	240
Ferro-manganese	38 000 tons	0.125	800	100
Ferro-chrome (low carbon equivalent)	12 500 tons	0.05	2 500	125
Rolling mills	100 000 tons	0.2	600	120
Aluminium	30 000 ingot tons	0.1	4 000	400
Power generation:				
Thermal	250 MW	0.24	4 000	960
Total				23 845
			Say	24 000

a/ Capacity installed during a period of five years divided by the number of years

b/ The norm relates to the expansion of steel plant

Table 10-55

ANNUAL REQUIREMENTS OF STEEL STRUCTURES FOR CHEMICAL AND OTHER INDUSTRIES BY 1977

Industry	Anticipated slab of investment in individual plant million Rials	Forecast of annual rate of investment in the industry million Rials	Proportion of bldg. cost including services per cent	Approximate proportion of cost of structural steelwork only a/ per cent	Approximate expenditure on structural steelwork only million Rials	Approximate requirement of steel structures b/ tons
Petroleum and petro-chemicals	Over 1 000	4 450 c/	5	2.75	122.54	
Fertilisers	Over 1 000	450 d/	5	2.75	12.35	
Sugar	Under 200	300 e/	15	8.25	24.75	
Cement	Between 200 and 1 000	650 f/	11	5.5	35.75	
Chemicals (other than petro-chemicals)	33.33%: Under 200	120 g/	15	8.25	9.90	
	66.66%: Between 200 and 1 000	240 g/	6	3.3	8.71	
					214.00	7 135

a/ The structural steelwork cost approximates 55 per cent of the total building cost including services

b/ Estimated at 30,000 Rials/ton as erected and site painted.

c/ Out of total outlay on oil and gas, 25 per cent allocation is assumed for gas and 25 per cent of the residual value for oil exploration and transport.

d/ Assuming a 42 million $ fertiliser plant to be built every seven years.

e/ 1.4 plants of 2,000 tons/day beet crushing capacity at 2.9 million $ each including offsite facilities or 2.5 million $ each excluding offsite facilities.

f/ 2 plants of 600 tons/day clinker capacity at 4.275 million $ each.

g/ The outlay on chemical equipment in 1977 is expected to be of the order of 250 million Rials. Assuming this outlay to be about 70 per cent of the investment in the chemical industry, the total investment works out to 360 million Rials.

2. Indigenous capacity and shortfall

Public sector capacity: Provision for fabrication of about 1,000 tons of structural steelwork per year is reported to have been made in a railway wagon and road trailer plant to be set up in Iran. Fabrication of heavy structural steelwork in the machine building plant at Arak is not envisaged.

Private sector capacity: Cyrus Arjomand Works, Teheran, have a well-equipped workshop. Their annual production has been planned to be raised shortly to 12,000 tons per year. However, about half the quantity of production in this factory is likely to consist of chemical equipment and water supply tanks. This company can therefore be expected to supply about 6,000 tons of medium and heavy structures per year. Other established fabricators in Iran are Chakosh Company, Teheran, Farman Farmaian Nyer Press - Moghadam, Norm Co., Zigana Company, and Lulch Va Machine Sari Iran Company - Teheran, Azeri Company, Donyach Feles, Mashinsari Iran.

Though the combined fabrication capacity of these small establishments is of the order of 15,000 to 20,000 tons per year, their capacity to fabricate heavy structures can be considered limited to around 2,000 tons per year.

Shortfall

Thus, the shop capacity available in Iran for fabrication of heavy structures will aggregate only 10,000 tons per year, leaving a shortfall of about 32,000 to 35,000 tons between demand and capacity for supply of heavy structures in the country.

3. **Suggested manufacturing programme**

Production capacity: 10,000 tons per year of heavy structures with the plant working two shifts.

Heavy structural steelwork involving individual components weighing over 3 to 4 tons and constituting about 20 per cent of the whole structure by weight.

Crane girders (but not cranes)

Weldments only of heavy machines

Hydraulic gate parts without electrical and mechanical operating mechanisms.

4. **Major production and maintenance departments**

1. Template shop
2. Fabrication shop
3. Assembly shop
4. Inspection, painting and dispatch bay
5. Machinery maintenance shop

PLANT FOR LIGHT AND MEDIUM WEIGHT FORGINGS

1. Demand forecast for requirements of forgings of major consumers

The requirement of light and medium weight forgings for original parts in Iran is broadly estimated in Table 10-34.

The aggregate demand for light and medium weight forgings for original as well as replacement parts by major consumers will be as summarised below:

	Demand for forgings - ton					
	1972		1977		1982	
Item	Light a/	Medium b/	Light	Medium	Light	Medium
Original parts	10 119	7 905	20 111	16 185	36 322	28 938
Replacement parts @ 10%	1 010	790	2 010	1 620	3 632	2 894
Total	11 129	8 695	22 121	17 805	39 954	31 832

a/ Light forging is the one weighing up to 10 kg

b/ Medium forging is the one weighing up to 25 kg

The following major consumers are excluded, as bulk of their requirements is for heavy forgings:

1. Ordinary and alloy steel production
2. Metallurgical equipment
3. Mining machinery for coal and other minerals
4. Cement production
5. Locomotives
6. Heavy electrical equipment like turbines and generators
7. Forged rolls for steel rolling mills
8. Moulds for cast iron spun pipe production
9. Crank shafts for automobiles

Table 10-34

REQUIREMENTS OF FORGINGS FOR ORIGINAL PARTS BY MAJOR CONSUMERS

End-user product	Approximate consumption norms of steel forgings: Unit of production	Approximate consumption norms of steel forgings: Average requirements of steel forgings in kg/unit of production	Estimated forgings requirements for original parts - tons a/: 1972 Light weight	1972 Medium weight	1977 Light weight	1977 Medium weight	1982 Light weight	1982 Medium weight
Automobiles								
i) Buses & minibuses	single unit of average size	250	1 125 (9 000)	1 125	3 125 (25 000)	3 125	5 625 (45 000)	5 625
ii) Motor cars	-do-	180	4 500 (50 000)	4 500	8 370 (93 000)	8 370	14 580 (162 000)	14 580
iii) Trucks	-do-	350	1 137 (6 500)	1 137	2 188 (12 500)	2 188	3 850 (22 000)	3 850
iv) Jeeps and station wagons & vanets	-do-	135	945 (14 000)	945	1 890 (28 000)	1 890	3 375 (50 000)	3 375
Rolling stock								
i) Wagons	-do-	300	29 (100)	72	112 (300)	288	290 (1 000)	720
ii) Passenger coaches	-do-	100	(-)		(-)		(-)	
Industrial and agricultural machinery								
i) Agricultural tractors	-do-	150	263 (2 500)	112	526 (5 000)	224	1 052 (10 000)	448
ii) Stationary diesel engines	-do-	135	121 (1 000)	14	900 (7 500)	100	3 060 (25 000)	340
iii) Small tools and hand tools	tons		2 000 (2 000)	-	3 000 (3 000)	-	4 500 (4 500)	-
Total			10 119	7 905	20 111	16 185	36 322	29 239

10 - Development of steel industry (cont'd)

3. Major production and maintenance departments

1. Scrap preparation
2. Steelmelt shop, ingot stripping/mould preparation
3. Calcining plant
4. Soaking pits
5. Blooming mill
6. Billet conditioning
7. Bar mill
8. Heat treatment and finishing facilities
9. Metallurgical laboratory
10. Roll turning and maintenance shop.

ii) Passenger coaches	-do-	100	(-)		(-)		(-)	
Industrial and agricultural machinery								
i) Agricultural tractors	-do-	180	285 (2 500)	112	526 (5 000)	224	1 082 (10 000)	449
ii) Stationary diesel engines	-do-	135	121 (1 000)	14	900 (7 500)	100	3 080 ([illegible] 000)	340
iii) Small tools and hand tools	tons		2 000 (2 000)	-	3 000 (3 000)	-	4 500 (4 500)	-
Total			10 119	7 985	20 111	16 198	36 322	29 352

/ Figures in brackets indicate output forecast of respective end user products

SECTION 2

Table 10-54

10 - Development of steel industry (cont'd)

2. Indigenous capacity and shortfalls

A common forging plant is proposed to be set up by the automobile manufacturers, besides captive forge shops planned for the tractor plant and the machine building plant in the Public Sector. The supply of light and medium weight forgings from these three forge shops is expected to be about 28,000 tons in 1977 and 45,000 tons in 1982, leaving shortfalls of about 14,000 and 27,000 tons in the corresponding periods.

3. Suggested manufacturing programme

Plant capacity	:	About 8,000 tons per year of plain carbon and alloy steel forgings, working two shifts per day.
Parts to be manufactured	:	Agricultural tractor parts and auto parts for cars, buses, minibuses, trucks, jeeps, station wagons etc (camshafts, axles, rocker arms, clutch levers). Electrical equipment parts (components of electrical machinery and switchgears, starters) Engineering forgings (components of compressors, internal combustion engines, pumps, valves, forged rings, gear blanks). Railway wagon parts (coupler hooks, brake lever, door fittings). Forgings for industrial plant and equipment (grinding & crushing machines, conveying & lifting machines, crane & winch parts). Machine tool parts (shaping & milling machines, lathes, drills, presses). Miscellaneous (hand tools).

10 - Development of steel industry (cont'd)

Maximum unit weight : Die forgings about [illegible] kg
of forgings

Press forging about [illegible] mm diameter

6. Major production and maintenance departments

1. Forging shop
2. Heat treatment shop
3. Finishing shop
4. Die-shop and machine shop

10 - Development of steel industry (cont'd)

SEAMLESS STEEL TUBE PLANT

1. Demand for seamless steel tubes

Both demand and shortfalls of seamless steel tubes projected in this study are 135,000 tons by 1977 and 288,000 tons by 1982. The shortfalls cover the entire size range from 15 mm to 600 mm nominal bore.

2. Suggested manufacturing programme

The entire size range cannot economically be covered by one seamless steel tube plant. A plant of 80,000 tons per year capacity in the size range of 50 mm to 500 mm diameter is suggested. The tentative product-mix of this plant may be as follows:

			Production tons/year
Pipes			
Oil country goods:			
i)	Casing pipes	- J-55 grade	15 500
ii)	Casing pipes	- N-80 grade	8 000
iii)	Tubing pipes	- J-55 grade	3 300
iv)	Tubing pipes	- N-80 grade	1 800
v)	Drill pipes	- D grade	300
vi)	Drill pipes	- E grade	100
	Line pipes	- plain ended	4 500
	Line pipes	- threaded ended	7 000
	Pressure and standard pipes	- plain end	1 500
		threaded end	18 000
Tubes			
	Pressure tubing	- carbon steel	5 000
	Pressure tubing	- alloy steel	2 500
	Mechanical tubing	- carbon steel	12 000
	Mechanical tubing	- alloy steel	2 500
	Total		80 000

10 - Development of steel industry (cont'd)

3. Major production and maintenance departments

1. Bloom preparation i.e. scarfing and cutting-to-length facilities
2. Reheating furnaces for blooms/ingots and pierced bottles
3. Bottling and piercing press
4. Elongating mills
5. Pilger mills
6. Reheating furnace for pilgered tube
7. Sizing mill
8. Stretch reducing mill
9. Cold drawing equipment
10. Finishing facilities such as tube end threading, upsetting and normalising
11. Socket shop
12. Hydraulic and pneumatic stations
13. Mandrel shop
14. Pipe and fittings shop
15. Roll turning shop

10 - Development of steel industry (cont'd)

COLD ROLLED STRIP MILL

1. Demand for cold rolled sheets

The broad breakdown of demand for cold rolled sheets of forecast in this study is summarised in Table 10-55.

Width of sheets/coils

A major proportion of cold rolled sheets is required in widths under 1,100 mm, as shown below:

End-use of cold rolled sheets	Width required in mm
Tinplates	600 to 1016 (40")
Corrugated galvanised sheets	915 maximum
Plain galvanised sheets	762, 915 and 1220
Metal working industry	
i) Drums and containers ii) Profiles, i.e. door & window frames iii) Builders' hardware iv) Gas cylinders v) Stores	Under 1100
Electric appliances	
i) Water coolers ii) Water heaters iii) Electric fans iv) Radio receivers v) House service meters	Under 1100
Transport equipment	
i) Motor cycles ii) Bicycles	Under 1100

SECTION 1

Table 10-35

SECTORWISE DISTRIBUTION OF DEMAND FOR COLD ROLLED SHEETS

Item	Used for	Demand for cold rolled sheets 1977 '000 tons	1977 per cent of total	1982 '000 tons	1982 per cent of total
Uncoated sheets/coils	1. Metal working industries				
	i) Furniture	27.0	4.40	47.5	4.50
	ii) Other industries	173.0	23.20	307.5	29.10
	Sub-total	200.0	32.60	355.0	33.60
	2. Automobile industries				
	i) Cars	55.5	9.00	97.4	9.20
	ii) Jeeps, station wagons, ambulances & vannets	11.2	1.80	20.0	1.90
	iii) Other vehicles & ancillaries	51.3	8.40	92.9	9.90
	Sub-total	119.0	19.20	210.3	19.90
	3. Electrical equipment & appliances				
	i) Refrigerators	44.0	7.20	79.0	7.20
	ii) Other equipment & appliances	14.0	2.00	33.7	3.00
	Sub-total	58.0	9.20	109.0	10.20
	4. Transport equipment other than automobiles	1.3	0.20	2.5	0.20
	5. Industrial and agricultural machinery	8.2	1.30	13.3	1.30
	6. Miscellaneous				
	i) Small scale industries	23.0	3.80	66.0	6.20
	ii) Spares and maintenance	39.0	6.30	65.0	6.10
	iii) Incremental stock	6.0	1.00	11.0	1.10
	Sub-total	68.0	11.10	142.0	13.40
	Sub-total for all uncoated sheets	450.5		931.1	
Coated	7. Galvanised sheets a/				

Table 10-58

	6. Miscellaneous				
	i) Small scale industries	23.0	3.80	66.0	6.20
	ii) Spares and maintenance	39.0	6.30	65.0	6.10
	iii) Incremental stock	6.0	1.00	11.0	1.10
	Sub-total	68.0	11.10	142.0	13.40
	Sub-total for all uncoated sheets	450.5		931.1	
Coated sheets/coils	**7. Galvanised sheets** a/				
	i) Roofing	68.9	11.20	105.0	9.90
	ii) Industrial uses (assuming 94% as cold rolled)	19.0	3.10	27.0	2.60
	iii) Incremental stock	0.9	0.10	2.5	0.20
	Sub-total of galvanised sheets	88.8	14.40	134.5	12.70
	8. Tinplates				
	i) For tin cans	73.0	11.90	90.6	8.60
	ii) Incremental stock	0.8	0.10	1.4	0.10
	Sub-total of tinplate	73.8	12.00	92.0	8.70
	TOTAL	613.1	100.0	1 057.6	100.0

a/ The requirements of cold rolled sheets/strips are less than the requirements of galvanised sheets to the extent of weight added by the zinc coating on black plates.

SECTION 2

10 - Development of steel industry (cont'd)

The requirements of sheets in widths exceeding 1,250 mm have been estimated on a liberal basis in Table 10-36 for all industries consuming wide sheets.

Table 10-36

REQUIREMENT OF WIDE COLD ROLLED SHEETS

End user industry	Estimated proportion of wide sheets	Forecast of requirements of cold rolled sheets			
		1977		1982	
	per cent	Total tons	Sheets wider than 1250 mm tons	Total tons	Sheets wider than 1250 mm tons
Buses & minibuses	10	37 500	3 750	67 500	6 750
Cars	20	55 500	11 100	97 400	19 480
Trucks	5	12 500	625	22 000	1 100
Jeeps, station wagons, ambulances & vannets	30	11 200	3 360	20 000	6 000
Furniture	25	26 900	6 700	48 000	12 000
Refrigerators	10	44 400	4 400	79 000	7 900
Switchgears & control gears	25	1 160	290	2 900	725
Air-conditioners	5	2 600	130	14 400	720
Water coolers	5	4 080	204	6 480	325
Agricultural tractors	5	1 075	55	2 180	110
Chemical equipment	20	4 800	960	7 500	1 500
Miscellaneous machinery	20	2 300	460	3 600	720
Total	..		32 034		57 330

10 - Development of steel industry (cont'd)

The requirement of sheets in widths exceeding 1,250 mm is summarised below:

Year	Total requirement of cold rolled sheets (coated & uncoated) tons	Requirements of sheets wider than 1,250 mm tons	Proportion of wide sheets in total requirements per cent
1977	615 100	32 000	5.20
1982	1 057 600	57 300	5.40

It is suggested that wide sheet requirements amounting to only 6 to 6.5 per cent of the total be met by imports, and indigenous capacity be developed for cold rolling sheets up to 1,250 mm. (This proposal will also ensure reduction in the cost of hot strip mill that might be installed in future as hot rolled strip width can be limited to 1,350 mm. The largest single user of hot rolled coils in Iran will be heavy ERW tubes and pipes and the maximum width of hot rolled strip required by Ahwaz pipe mill to produce 16 inches diameter tube will not exceed 1,300 mm).

Thickness of sheets/coils

The thickest cold rolled sheets required are 3, 4 and 5 mm in thickness for making 15, 50 and 100 kg liquefied petroleum gas cylinders respectively. However, the requirement of 50 and 100 kg gas cylinders which are mainly used

FERRO-CHROME PLANT

1. Demand for ferro-chrome

As ferro-chrome is required for the production of alloy steels and stainless steels only, internal demand for ferro-chrome in Iran will remain small for many years to come. Reckoning total consumption of all grades of ferro-chrome at 6 kg/ton of alloy and stainless steels, the requirement of ferro-chrome for production of 60,000 and 100,000 tons of alloy steels will be only about 360 and 600 tons respectively. However, there is a large demand for ferro-chrome in the international market and ferro-chrome produced in Iran could be exported.

2. Suggested product-mix

Analyses of the intermediate and final products and the outputs suggested are given below:

Grade of ferro-chrome	Composition of ferro-chrome					Rated capacity
	Cr %	C %	Si % max	P % max	S % max	tons/year
High carbon ferro-chrome	67	6	1.5	0.05	0.08	4 500
Silico-chrome	40	0.04	45	0.08	0.05	(in process material)
Low carbon ferro-chrome	68	0.1 max	0.08	0.08	0.04	10 000

3. Major production sections

1. Raw materials handling section including
   i) rotary kiln for drying chrome ore
   ii) rotary kiln for calcining limestone
2. Smelting furnace
3. Slag furnace
4. Tapping and finishing equipment

for industrial applications which be only 5 per cent of the total requirement of gas cylinders and can be excluded from the product-mix. The thinnest uncoated cold rolled sheet required is 0.6 mm (24 G) for several applications such as drums, containers and automobile parts. Bulk of the requirement is in the range of 0.8 to 1.6 mm thickness. Plain galvanised sheets used predominantly for industrial applications have thickness varying from 0.8 mm to 1.6 mm. Thickness of corrugated galvanised sheets in Iran ranges from 0.3 mm to 0.6 mm. The thinnest cold rolled sheets of 0.25 and 0.3 mm thickness are required for tin plates. Hence, sheets thinner than 0.6 mm for corrugated galvanised sheets and tin plates constitute about 22 to 25 per cent of the total requirement of cold rolled sheets in Iran.

2. Suggested manufacturing programme

Production capacity	:	400,000 tons per year of cold rolled sheets on two shift basis
Maximum width of sheets/coils	:	1,250 mm
Thickness of sheets/coils	:	0.25 mm to 3 mm
Finish	:	Skinpass, quarter-hard, half-hard and full-hard

10 - Development of steel industry (cont'd)

3. Major production and maintenance departments

1. Continuous pickling unit
2. Cold rolling mill
3. Annealing furnaces
4. Temper mill
5. Slitting and cut-to-length lines and packing
6. Roll grinding/turning shop

10 - Development of steel industry (cont'd)

ELECTROLYTIC TINNING AND CHROMIUM COATING LINE

1. Demand for tinplates and chromium-coated sheets

Tinplates can be substituted by chromium-coated sheets for the applications shown in Table 10-37 for which tinplates of coating weight not more than 0.50 lb per base box, i.e. 11.2 gms/sq m can be used. Chrome coating is not only cheaper than tin coating, but would also be in the interest of Iran's national economy which would have to depend on imports for tin.

Table 10-37

DEMAND FOR CHROMIUM COATED SHEETS

Product to be canned	Estimated demand of chromium-coated cans 1972 tons	[illegible] tons	[illegible] tons
Food products			
Biscuits and confectionery	5 500	8 500	13 000
Barley	2 600	3 100	3 [illegible]
Processed non-acidic food ..	1 490	2 6[illegible]	3 [illegible]
Tea	720	850	[illegible]
Miscellaneous products like coffee, cashew nuts, carbonated beverages @ 20% of above	2 100	[illegible]	[illegible]
Sub-total ..	12 410	17 [illegible]	[illegible]
Non-food consumer products			
Oil and lubricants a/ ..	9 750	13 500	18 750
Paints and varnishes ..	1 080	1 450	1 [illegible]
Shoe polishes ..	450	560	650
Miscellaneous products like toys & trays, crown corks, printing inks @ 20% of above	2 [illegible]	3 000	[illegible]
Sub-total ..	[illegible]	[illegible]	[illegible]
Total for cans ..	[illegible]	[illegible]	[illegible]
Total requirement of chromium-coated sheets b/ ..	[illegible]	39 [illegible]	[illegible]

a/ Kerosene tins estimated to constitute 25 per cent of the total for oils and lubricants have been excluded from this list, as special welding facilities required for sealing seams of the tins are not likely to be installed, unlike tinplate seams which can be closed by soldering, though tinplates can be substituted by chromium-coated sheets for corrosion resistance.

b/ Making 10 per cent allowance for wastage and 1 per cent for stocks.

Apart from this substitution of tinplates, chromium-coated sheets are finding applications on their own merits in new fields on account of certain superior characteristics. For example, as the melting point of chromium is higher than that of tin, these sheets can be used for making high temperature pots, gaskets etc where more expensive materials are being used at present. The single electrode potential of the chrome coating being close to that of zinc (-0.76 volts), these are being used as a cheaper substitute for zinc for making dry battery cells in industrially advanced countries.

Electrolytic tinplate for the applications enumerated in Table 10-[illegible] is unlikely to be substituted by chromium-coated sheets on account of the present technological limitations of chromium coating.

Table 10-[illegible]

DEMAND FOR ELECTROLYTIC TINPLATE

Product to be canned	Tin coating weight/a lb/base box	Tin coating weight/a g/m²	Demand forecast for cans of electrolytic tinplate [illegible] tons	[illegible] tons	[illegible] tons
Vegetables and hydrogenated oils	0.75	16.8	11 700	10 970	13 [illegible]
Milk products ..	0.75	16.8	800	1 000	1 300
Kerosene ..	1.00	22.4	3 [illegible]	4 [illegible]	6 [illegible]
Miscellaneous products @ [illegible] of above	0.75/1.00	16.8/22.4	[illegible]	[illegible]	[illegible]
Total for cans ..			[illegible]	[illegible]	[illegible]
Total requirement of electrolytic tinplate/b			[illegible]	[illegible]	[illegible]

a/ The base box (BB) is the unit of measurement of tinplates in the United States; the area of this base box is defined as 31,360 inch² (20.232 sq m) which is the area (one side) of 112 sheets, 14 in x 20 in; [illegible] is the corresponding unit of measurement of tinplates in the United Kingdom, the area of this base box being 100,000 inch², measured on one side.

b/ Making 10 per cent allowance for wastage and 1 per cent for stock.

10 - Development of steel industry (cont'd)

Tinplate requiring tin coating of 0.75 and 1.0 lb per base box (16.8 and 22.4 gms/sq m) can be coated with tin of required thickness on one side and 0.25 lb per base box (5.6 gms/sq m) on the other face (differentially coated tinplate). The proportion of 0.25 lb/BB and 0.50 lb/BB electrolytic tinplate (which are proposed to be substituted by chromium-coated plates) works out to 88/84 per cent and compares well with the figure of 80 per cent obtaining in the United States.

It has not yet been found to produce electrolytic tinplates with a coating thickness of 1.25 lb/BB (28 gms/sq m) and heavier required for cans for packing acidic fruits and pharmaceutical products. Tinplates with coating thickness of 1.25 lb/BB and heavier are made by hot process. Requirements of tinplates for these applications are excluded from the scope of this expansion project. Similarly, doubly reduced very thin chromium-coated plates and tinplates in the thickness range of 0.15 mm to 0.18 mm which are marketed in western countries to counter the increased competition to steel in the container industry from substitute materials like aluminium, paper and glass.

10 - Development of steel industry (cont'd)

Tin-free chromium-coated sheets require finishing treatment in the form of lacquering to [illegible] their corrosion resistance [illegible] by [illegible] processes like [illegible], while lacquering is optional with other processes like [illegible].

9. [illegible]

Capacity	:	[illegible] tons/year chromium-coated sheets [illegible] tons/year electrolytic tinplate
Types of product	:	Electrolytic tinplate and tin-free chromium coating
Width	:	[illegible] - 1,[illegible] mm
Coating weight for electrolytic tinplate	:	Differential coating of [illegible] lb/BB on one side and [illegible] lb/BB on the other side
Coating thickness for tin-free steel	:	[illegible]

9. [illegible]

1. [illegible]
2. Cleaning and pickling [illegible]
3. Chromium-coating and tinplating [illegible]
4. Post-plating eq. for flow-melting of coating, [illegible]
5. Cutting/shearing and classification [illegible]
6. Packing

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

10 - Development of steel industry (cont'd)

Thickness of sheets

The minimum thickness of galvanised sheets in several countries of the west, e.g. United States, United Kingdom and Sweden is 0.4 mm. In contrast, about two-thirds of the total production of galvanised sheets in Japan is under 0.5 mm in thickness. It seems reasonable to anticipate that the consumption pattern of galvanised sheets in Iran will lie between those two extremes. The pattern of demand shown in Table 10-40 can therefore be assumed for Iran.

Table 10-40

LIKELY PATTERN OF DEMAND FOR GALVANISED SHEETS

Product and consuming sector	Approximate proportion to total requirement of sheets per cent	Sheet thickness mm
Corrugated sheets: Social services, agriculture and allied activities, irrigation, some medium industries	33	0.25, 0.3
Corrugated sheets: Large and medium industries & mining, airports, ports and harbours, power supply, oil and gas	42	0.5, 0.6, 0.75
Plain sheets: Airconditioners, telecommunications, oil and gas, power supply, ports and harbours, miscellaneous sectors like irrigation, airports, social services, large and medium industries etc	15	0.8, 1.0
Plain sheets: Buses and minibuses, trucks, automobile ancillaries, roads and bridges	10	1.1, 1.25, 1.40, 1.60
	100	

10 - Development of steel industry (cont'd)

Width of sheets

In countries like Iran, where bulk of the requirement of galvanised sheets amounting to about 75 per cent is in the form of corrugated sheets for roofing and cladding purposes, sheets of narrow widths ranging from 650 mm to 915 mm (36") figure prominently in the demand. According to American practice, the standard 63.5 mm (2½") corrugated sheets have ten corrugations to a sheet of siding and 10½ corrugations for a sheet of roofing for a covering width of 610 mm (24"). The overall widths of these sheets are therefore 660 mm and 700 mm for cladding and roofing respectively. The standard sheets in British practice have 7 and 10 corrugations of 3" with the respective developed widths of 743 mm (29¼") and 915 mm (36"). Irrespective of which of these two practices is adopted by Iran, at least 70 per cent of requirements will be in widths less than 915 mm. However, as the capital cost difference between 915 mm and 1,220 mm wide galvanising lines is of the order of 3 to 4 per cent only, it is considered desirable to install a 1,220 mm wide line to permit greater flexibility in the product-mix.

Thickness of zinc coating

A rough break-down of coating thickness requirements of major consuming sectors in Iran will be as indicated in Table 10-41.

10 - Development of steel industry (cont'd)

Table 10-41

PROBABLE REQUIREMENT OF ZINC COATING THICKNESS

End use	375, 450 g/m²			525, 600 g/m²			675, 750 g/m²		
	Proportion per cent	1977 tons	1982 tons	Proportion per cent	1977 tons	1982 tons	Proportion per cent	1977 tons	1982 tons
Social services	80	18 640	22 000	20	4 660	5 500	-	-	-
Agriculture and allied activities	80	4 560	5 760	20	1 140	1 440	-	-	-
Irrigation	80	3 240	4 400	20	810	1 080	-	-	-
Large and medium industries & mining	50	20 250	34 100	40	16 200	27 280	10	4 050	6 820
Roads and bridges	-	-	-	50	3 300	7 000	50	3 300	7 000
Ports and harbours	40	[illegible]	[illegible]	60	[illegible]	10 440	-	-	-
Total		[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]

The proportion of sheets with different coating thicknesses are as follows:

Zinc coating g/m²	Proportion of sheets by weight 1977 per cent	1982 per cent
375, 450	[illegible]	[illegible]
525, 600	[illegible]	[illegible]
675, 750	[illegible]	[illegible]
	100.0	100.0

This pattern of coating thickness can be considered applicable pro-rata to the entire demand forecast for galvanised sheets.

MALLEABLE IRON CASTINGS FOUNDRY

1. Demand for malleable iron castings

The demand for malleable iron castings for the years 1972, 1977 and 1982 as estimated earlier is summarised in Table 10-20 from which it will be seen that about 85 of the demand will be for the automotive sector.

Table 10-20

SECTORWISE DEMAND FORECAST FOR MALLEABLE IRON CASTINGS

Group of manufactured items	1972		1977		1982	
	Quantity tons	Proportion %	Quantity tons	Proportion %	Quantity tons	Proportion %
Transport equipment ..	5 882	85.00	12 316	84.00	21 882	84.20
Electrical equipment ..	2	0.02	5	0.04	15	0.05
Industrial & agricultural machinery ..	133	1.98	388	2.66	688	2.65
Other items ..	901	13.00	1 906	13.30	3 387	13.10
Non-industrial castings ..	-	-	-	-	-	-
Total ..	6 918	100.00	14 615	100.00	25 967	100.00

10 - Development of steel industry (cont'd)

2. <u>Indigenous capacity and shortfalls</u>

The capacity of sheet galvanising plant installed by Sepanta Industrial and Commercial Company is 15,000 tons per year. Hence shortfalls of about 80,000 and 140,000 tons per year are anticipated in sheet galvanising capacity.

3. <u>Suggested manufacturing programme</u>

Capacity	:	56,000 tons/year of corrugated sheets 24,000 tons/year of plain sheets
Type of product	:	Hot dip galvanised sheets
Width	:	600 - 1,220 mm
Zinc coating weight	:	375, 450, [illegible], 600, 675 and 750 gm/m^2

4. <u>Major production sections</u>

1. Entry zone for black plate including uncoiler, shear and welder
2. Pre-cleaning of strip by heating for volatisation of rolling oil and to form a thin oxide film on the surface
3. Annealing and cooling to galvanising temperature in reducing atmosphere
4. Galvanising bath
5. Cooling/shearing and classification line
6. Packing

10 - Development of steel industry (cont'd)

GREY IRON CASTINGS FOUNDRY

1. Demand for grey iron castings

The grey iron castings can be generally divided into the following groups:

i) Ingot moulds, stools etc required for production of steel in integrated steel plants;

ii) Spun pipes;

iii) Sleepers for railway tracks;

iv) Engineering castings for components of transport and industrial and agricultural equipment;

v) Non-industrial castings such as manhole covers, soil water pipe etc.

Due to the adoption of continuous casting technique in the steel plants and fairly high standard of living and wages in Iran, the demand of grey iron castings will be negligible for the first three items. The demand for engineering as well as non-industrial castings forecast in this study is grouped in Table 10-[illegible] according to the user sector. This can be further divided into three groups according to their weight as shown in Table 10-[illegible], the criteria for classification being same as those for Table 10-[illegible].

10 - Development of steel industry (cont'd)

Table 10-62

[illegible] DEMAND FORECAST FOR GREY IRON CASTINGS

Group of user industries	[illegible] Quantity tons	[illegible] Proportion %	1977 Quantity tons	1977 Proportion %	[illegible] Quantity tons	[illegible] Proportion %
Transport equipment ..	21 0[illegible]	37.0	64 6[illegible]	34.[illegible]	70 245	30.5
Electrical equipment ..	[illegible]	6.[illegible]	7 [illegible]	[illegible].6	12 966	6.1
Industrial & agricultural machinery ..	[illegible]	14.4	56 70[illegible]	27.[illegible]	59 820	28.5
Other items ..	[illegible]	[illegible]	13 125	10.[illegible]	22 662	10.7
Non-industrial castings ..	[illegible]	[illegible]	[illegible]	[illegible]	34 73[illegible]	[illegible]
Total ..	[illegible]	[illegible]	1[illegible]	100.0	208 417	100.0

Table 10-43

CLASSIFICATION OF GREY IRON CASTINGS FOR MAJOR USES

Manufactured item		1977			[illegible]		
		Light tons	Medium tons	Heavy tons	Light tons	Medium tons	Heavy tons
Buses and minibuses	..	2 220	4 180	3 630	3 996	7 470	6 [illegible]
Trucks	..	1 110	2 075	1 815	1 [illegible]	3 [illegible]	3 194
Cars	..	5 [illegible]	15 [illegible]	-	9 [illegible]	27 572	-
Jeeps, station wagons, ambulances and vanets	..	1 [illegible]	2 [illegible]	2 [illegible]	2 700	5 175	4 [illegible]
Refrigerators	..	3 000	-	-	6 372	-	-
Tractors	..	[illegible]	2 062	1 [illegible]	1 190	4 004	2 672
Power-driven pumps	..	1 [illegible]	3 060	127	2 [illegible]	5 775	190
Textile machinery	..	4 [illegible]	3 300	[illegible]	7 [illegible]	4 980	12 375
Road rollers	..	4	21	1 475	6	[illegible]	2 [illegible]
Weighing machinery	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	..	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Proportion		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

10 - Development of steel industry (cont'd)

2. Indigenous capacity and shortfalls

The capacity of grey iron foundries already installed as well as those under construction is summarised in Table 10-44.

Table 10-44

GREY IRON FOUNDRIES IN IRAN

Foundry		Production capacity tons/yr	Type of grey iron castings
Existing:			
Machine Sazi Iran	..	20 000	Pipes and fittings
Pars Metal	..	5 000	Pipes and fittings
Sigma	..	2 500	Pipes, radiators for central heating
State Railway	..	1 500	Brake blocks
Abadan Refinery Workshop	..	1 000	
Sub-total	..	30 000	
Under construction:			
Isfahan Steel Plant	..	2 500	Component parts of equipment - about 19,000 tons per annum being captive capacity for this purpose
Machine Building Plant, Arak	..	2 500	
Machine Tool Plant, Tabriz	..	7 500	
Tractor Plant	..	14 000	
Sub-total	..	26 500	
Total	..	[illegible]	

10 - Development of steel industry (cont'd)

The anticipated shortfalls in the grey iron foundry capacity are as follows:

Grey iron castings		1977 tons/yr	1982 tons/yr
Demand	.. ..	180 800	208 400
Selected quantity for production	.. ..	90 000	180 000
Available installed capacity	.. ..	[illegible]	[illegible]
Shortfall	..	[illegible]	[illegible]

3. Suggested manufacturing programme

Production capacity : 15,000 tons per year made up as follows:

Grade of casting Ultimate tensile stress kg/mm²	Production capacity tons/yr
22 to 27	6 000
28 to 32	6 000
33 to 37	2 000
38 to 42	1 000
	15 000

Parts to be manufactured: Textile machinery components, parts of automobiles other than the engine, components of water pumps etc.

4. Major production and maintenance departments

1. Pattern making
2. Sand conditioning and preparation
3. Mould and core-making
4. Iron melting, pouring and stripping
5. Finishing, ie. sand blasting/shot blasting, fettling with grinding wheel, followed in many cases by rough machining and in some cases by enamelling bath.

M. N. DASTUR & COMPANY PRIVATE LTD

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

ASSESSMENT OF [illegible] [illegible] IN [illegible]

APPENDICES

Appendix [illegible]

IMPORTS [illegible]
(in figures [illegible])

[illegible]	[illegible] Turkey	Pakistan	[illegible] Turkey	Pakistan	[illegible]	[illegible] Pakistan
Ingots and scale	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Heavy and light sections	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Plates	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Strips	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sheets	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wire rods	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Round bars	[illegible]		[illegible]		[illegible]	
Tin plate	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Galvanised sheets	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Wire	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Steel pipes and tubes and fittings	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rails	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Railway materials	[illegible]				[illegible]	
Others	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

SECTION 1

SECTION 2

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]					
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SECTION 1

10 - Development of steel industry (cont'd)

A breakdown of the requirements of malleable iron castings of the major user sectors into three groups, namely light, medium and heavy according to their weight range is given in Table 10-21. Those castings which can be handled in a foundry without the need for any mechanised material handling facilities are considered light. Medium castings may be produced in partially mechanised foundries e.g. those having monorail gantries, whereas foundries for heavy castings will need overhead crane facilities, mechanisation of pouring facilities etc.

Table 10-21

CLASSIFICATION OF MALLEABLE IRON CASTINGS FOR MAJOR USES

	1977			1982		
	Light tons	Medium tons	Heavy tons	Light tons	Medium tons	Heavy tons
Buses and minibuses	263	1 875	1 612	472	3 375	2 903
Cars ..	56	3 664	-	98	6 382	-
Trucks ..	81	988	806	231	1 650	1 419
Jeeps, station wagons, ambulances and vannets ..	146	1 120	974	260	2 000	1 740
Bicycles ..	450	-	-	900	-	-
Tractors ..	104	96	-	208	192	-
Textile machinery	90	-	-	135	-	-
Total ..	1 190	7 743	3 392	2 304	13 599	6 062
Proportion	9.6%	62.9%	27.5%	10.4%	62.0%	27.6%

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SECTION 9

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10 - Development of steel industry (cont'd)

Sizes of castings

The weight ranges of a few typical automotive and railway castings are indicated in Table 10-22.

Table 10-22

WEIGHTS OF TYPICAL MALLEABLE IRON CASTINGS

Weight range of casting kg	Malleable iron casting components of Mercedes-Benz truck	Malleable iron casting components of Railway wagon
Up to 2	Wing nut Screw plug Pawl handle Wheel cap Ring differential adjuster	Swing door bolt guide, hand brake spindle bearing (small), vapour extractor cap, safety valve spring follower, side buffer recoil spring parting plate, auxiliary rubber spring plate
2 to 5	Front top cover Plummer block cover Centre bearing bracket Front spring shackle Front and rear of front spring brackets Rear of rear spring bracket	Buffing washer Axle box key plate Auxiliary spring bottom seat
5 to 10	Front of rear spring bracket Slide support Steering bracket	Auxiliary spring top seat Hand brake spindle bearing (large)
10 to 15	-	Hand brake wheels Top suction pipe tee connection
25 to 50	Rear axle housing	-

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2. Suggested manufacturing programme

Plant capacity: 6,000 tons per year made up as follows:

Grade of casting	Production capacity tons/year	Typical applications
Standard blackheart: Grade 32510 a/	4 800	Light sections for pipe fittings, automobiles, agricultural implements and electrical equipment
Grade 35018 a/	600	High-strength castings for railway wagons and oil field castings
Pearlitic	500	Wear-resistant parts of automobiles, agricultural implements and ordnance
Copper-alloyed	50	Corrosion-resistant castings subject to sulphurous atmosphere
Copper-molybdenum alloyed	50	Extra-high strength castings for expansion joints of bridges
	6 000	

a/ Specification A 47-52 of the American Society for Testing Materials.

Parts to be manufactured : Agricultural tractor parts and auto parts for cars, buses, minibuses, trucks, jeeps, station wagons etc. (pinion bearing cages, differential carriers, shift lever brackets, differential case, radiator case, screw backs, cam-shaft bracket, brake shoes); cycle and rickshaw fittings such as sockets, hubs, cranks etc.