(3) Compared with the available means employed by the state authorities in market economies, Polish transport authority employs only small means of available intervening measures. Particularly, the regulation of the quality of transport services and preventive measures for negative effects on environment are yet to be applied.

(4) In order to impose effective measures of state intervention, the monitoring of transport market, particularly that of transport enterprises' performance, is of paramount importance. A timely and flexible imposition of fine-tuning measures is indispensable for obtaining positive results and, for this purpose, the monitoring function and organizational structure of Polish transport administration need to be further strengthened.

2.4.3 Policy Measures for States Intervention

1) Technology Transfer of Measures for State Intervention

Lack of understanding of both administration authority and transport enterprises on the principles and mechanism of market economy system is quite understandable since the history of Polish exposition to the market economic system is short in period. In addition, the erosion of pay and competition for professional staff from the private sector have eroded the public service capacity, and the effectiveness of the transport administration appears to have gradually declined. Lack of public service capacity and of experience in the market economy system is the major bottle-neck of regulatory measures to the transport sector under reform.

To attract and retain competent personnel in the transport administration needs to be addressed on a broad scale and to be accompanied by other reforms to strengthen civil service management including career development, pay scales, staffing levels and personnel management. For the time being, the MTME needs to strengthen its capacity through staff training on the principles and mechanism of transport administration in the market economy system. The best way to leave the system would be to send the MTME staff to Ministries of Transport in EC countries if they are accepted by those ministries, or attach them to the Embassies of Poland in those countries for certain period and train them on the job. This scheme would be a best way of transfer for administrative and regulatory measures in market economy system. From this viewpoint following program of action are recommended to be considered.

(1) To request the technical assistance of MTME staff Training to Ministries of Transport in EC countries for certain periods (at least 2 years for each staff). The short-term course training will have only limited effects for this purpose and are not recommended. If the request is accepted, the outline of the scheme would be:

- attach 2 to 3 staff in the different divisions of Transport Ministry in each country;

- learn the principles and mechanism of transport markets, through actual administration in the market system;

- establish close Ministerial and personnel linkages with Transport Ministries and their staffs which would enable the returned staff to renew and update their knowledge; and

- enforce obligatory service period for the MTME staff sent to EC countries on this scheme after ending the training in those countries.

(2) If the above scheme were difficult to implement, the second best measures would be to send 1 or 2 MTME staffs to each Polish embassy in EC countries and indirectly learn the principles and mechanism of transport administration in attached countries.

2) Legal arrangements for the Use of Intervention Measures

Lack of knowledge on the available measures and their effectiveness can only be satisfied by the additional studies on those issues and the accumulation of experience in the actual administration. Therefore, the following actions would be useful:

(1) To establish an inter-departmental study group on transport laws and regulations in market economic countries (particularly those in EC countries) and their effectiveness for regulating transport market. The study group might be chaired by either representatives from Legal Department or by International Department.

(2) The applicability of intervention measures explained briefly in the above Section 2.4.1. to the Polish transport administration would be further studied by policy-oriented research institution such as OBET. Technical assistance would be sought from EC countries and/or international aid agencies.

3) Strengthening of Organizational Structure for State Intervention

The effective application of intervention measures heavily relies upon the monitoring capacities of the MTME. More broadly, the MTME needs to rethink and redefine the attributions and the competences of departments, and to determine to what extent they are compatible with the responsibility of transport administration. The present departmental structure lacks competence of handling modal issues, which need to be treated in a comprehensive manner and not be subdivided into functional attribution. The following actions would be desirable for the effective implementation of regulatory measures by the MTME.

(1) To study the each case of transport administration problems in detail from the viewpoint whether the MTME needs to have a function of modal administration in addition to the existing functional structure of departmental system.

(2) To study the use and effectiveness of regulatory measures in transport administration by the Transport Ministries in Western industrialized countries, particularly in EC countries, which are predominantly modal in their departmental structure (c.f.Annex 2).

2.5 Realignment within the MTME

2.5.1 Division of Roles and Competence Between State and Enterprises

1) Ongoing Revision of Roles and Competences

At present there exists three types of ownership in the transport sector, namely, state-owned, cooperative and private in Poland. The first two types had no dominant position until 1989. The rail transport sector which has been operated by the state-owned and monopolistic PKP, and the road transport, which had been operated by four state-owned and regional-monopolistic PKSs until its separation into small private enterprises in 1990, took dominant roles in passenger transport as well as in freight transport sector. Under the former system few private transport enterprises existed while transport cooperatives based on the Cooperative Law had relatively wide independence in decision-making of their operation. Independence of state-owned enterprises were considerably limited. Particularly the PKP was a part of Ministry of Transport until the end of 1987. The Minister of Transport was simultaneously appointed as the General Director of the PKP.

Demonopolization and privatization took place in the transport sector in 1990, which brought changes of roles and competence among transport administrative bodies and enterprises. Ownership of State-owned Enterprises was differentiated into properties of the State Treasury and Municipalities. The Minister's role has changed and the number of economic units for which the Minister of MTME is authorized by the act as the founding body has increased substantially. The Minister does not manage transport enterprises directly, but supervise them. However, the actual progress of demonopolization and privatization differs considerably by each mode of transport.

(1) Rail Transport

The reform of PKP is the most difficult and the slowest because its activities have been deeply linked to the state's transport build-up and became a monstrous undertaking. The following are current restructuring operations now undertaken by the government and the PKP:

- in accordance with the decision of the Economic Committee of the Council of Ministers and with the agreement with the World Bank, a PKP reform program was prepared by the Government's plenipotentiary team in 1990;

- the Team is responsible for the external reform of PKP including the separation of PKP affiliates, supervision of unprofitable normal and narrow gauge lines, etc.; and

- the General Director of PKP is responsible for the internal reform such as reduction of employees, reorganization of internal structure, etc.

Practical implementation of the reform of the PKP started in the later half of 1991 with separation of all the subsidiary works, and established 77 enterprises of 65,000 employees. Furthermore, operation was suspended on 611km of inefficient lines in 1991, and it is planned to suspend on another 1,000km of lines by the end of 1992. The difficulty of reforms lies on the assessment of real values of the subsidiary enterprise's properties, the book values of which are disproportionately overvalued.

(2) Road Transport

The reforms in the road transport sector took place in 1990. The former PKS enterprises were divided into independent enterprises of 25 passenger enterprises, 31 freight enterprises and 147 passenger-freight enterprises. The MTME is the founding body for the passenger and passenger-freight enterprises, while Voivodes are for the freight enterprises. However, majority of them are not appropriately prepared for their new roles. In particular they lack:

- suitably qualified personnel, particularly at a senior management level;
- clear vision of future orientation;
- solid financial basis for profitable operation and investments for modernization and renewals of facilities; and
- unclear legal arrangements.

These defects originate from lack of understanding or management of transport enterprises under market economy system for both the administrative side and restructured enterprises.

Another problem could be the establishment of small private enterprises for freight transport by the liberalization of entry to the transport and forwarding services, taking into near-future competition with enterprises in EC countries, the guidance by the MTME for establishing enterprises of competitive side would be necessitated.

(3) Air Transport

The reform of the air transport sector was begun by the Act on Restructurization of the LOT of June 1991. The LOT was restructured into a joint stock company with the state treasury's share of not less than 51%. The MTME is appointed as the State Treasury's representative.

Concerning the operation of airports, changes in the monopolistic position of PPL took place in 1991. Two private companies have registered and started the construction of airports, one of which is a joint-stock company participated by Katowice Voivode, six private entities and the Credit-Trade Bank. The Okecie Airport of Warszawa will be owned by the State Treasury as a one-person joint stock company. However, the privatization of PPL, as well as that of LOT, is facing troubles due to the unfavorable financial situation.

(4) Sea Transport

In the sea transport sector, 10 enterprises including the 3 ports, 3 repairing ship-yards, 2 under-water works enterprises, a sea service enterprises, and a deep-sea fishing enterprise were restructured into the one-person stock company owned by the State Treasury. The Minister of Ownership Changes was appointed as a State Treasury's representative for those entities. Since the sea transport is a component of the entire transport sector, the MTME should have been appointed as the representative of the State Treasury. Three Polish shipping enterprises are not yet restructured, but they are already in the process of preparing their restructuring.

2) Identified Problems

Poland has started an all out attempt of transforming its economic and social structure. Since its initiation, only three years have passed and it seems premature to make any concrete assessment of its results. Certainly Poland was institutionally not well prepared to initiate such historic attempt, and some problems which are taking place could be avoided if Poland would implement its reforms in a slower and steadier pace. But it could prolong the period of restructuring process: the assessment of success or not in the long-term perspective is not possible and not meaningful yet. Nevertheless, we can point out problems in the ongoing process, and consider the remedial measures.

(1) The transport sector reforms were implemented not only in the countries of former centrally-planned economy but also in many developed and developing countries of market economy. Past experience of these attempts indicate that they generally require longer periods than initially expected. The legislation of the act of restructuring is not the final goal of the process but rather a start of the lengthy period of adaptation to the situation and adjustment. The Polish general public and the government seem understandably anxious to seek the immediate results from the restructuring, but in fact it might be the start of its long process. The length of restructuring period depends on various internal and external factors.

(2) Viewing the ongoing process of changing roles and competence between the administrative authority of transport sector and transport enterprises, the process needs to be made to conform with the strengthening of the administrative capacity of proper guidance over the situation. The capacity of guidance would be strengthened through the improvement on the capacity of each official in civil services and that of institutional setup in the administrative authority, which is discussed in the following section.

2.5.2 Possible Revision of Organizational Structure of the MTME

1) Existing Organizational Problems in the MTME

As is repeatedly indicated in the preceding sections, the current difficulties in the restructuring process results from the following factors:

- difficulties which are imminent in any attempt of reforms;
- external factors are not favorable to the Polish reforms, particularly economic difficulties in EC countries and eastern neighbors;
- inexperience of general public and the administrative authority with the principles and mechanism of market economy; and
- institutional weakness in the administration of the transport sector.

Since the first two factors are uncontrollable to the administrative authority and the third factor depends on the accumulation of experience by trial-and-error process, the only controllable factor is the last one. It is felt that some elements of modal administrative structure need to be introduced to the existing organizations of the MTME from the viewpoints of strengthening monitoring functions through exchange of information, guiding function through planning and policy formation and implementation, and regulatory function through various measures of state intervention when such interventions are required to normalize the market.

2) Alternative Directions for Possible Revision of Organizational Structure

The existing departmental structure is shown in the Fig. 2.5.1. The structure is basically a functional one which means all the administrative issues are sorted out and divided to the functional departments, and policies to cope with those issues which are prepared by each functional department according to them functional. Some modal departments exist in the basically functional structure such as Departments of Land Traffic Administration, Sea and Inland Waterways Administration, and Shipping and Sea Ports. The Department of Sea Fishing belongs to the MTME, which seems to be a remnant of traditional Polish administration and may not be considered as a functional one.

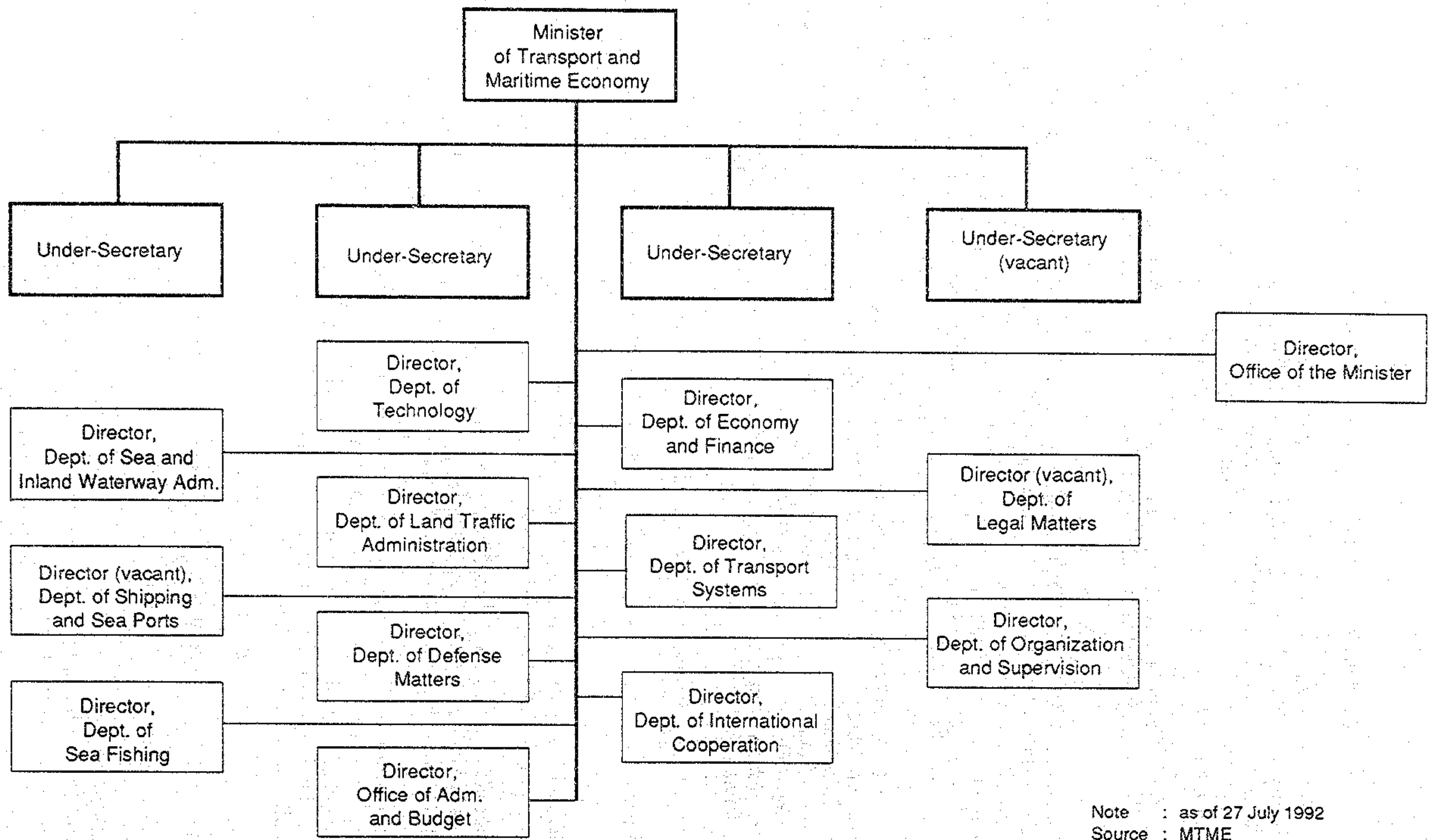
However, almost all the administrative issues of transport sector are difficult to be decided only by each functional department because all issues, whether they are technical, economic, legal or organizational nature, are closely interrelated and need an integrated decision-making. In the functional structure, the ideal approach to the solution would be to call upon concerned departments when any administrative issues arise. This approach is certainly inefficient and contradictory to the principle of departmental decision-making. The modal handling of transport issues seem to be more natural than functional handling since all transport activities are proceeded by modal enterprises. This view might be exemplified by the organizational structures of the Ministries of Transport in major industrial countries including Britain, France, Germany and Japan (c.f. Annex 2-1 - 4), in which general policy issues and inter-modal issues are handled by the Department of Transport Policy or the like. From this viewpoint, the introduction of modal elements in the structure of MTME is strongly recommended.

There are two alternative ways of introducing modal structure in the MTME:

Alternative 1 - to set up sections which handle modal issues within the Department of Transport Policy and Planning (Fig. 2.5.2)

Alternative 2 - to reorganize the departmental structure of the MTME and set up modal departments (Fig. 2.5.3)

Alternative 2 is a more fundamental revision of the existing structure and needs to revise existing statute of organization of the MTME, January 1990, and complete reestablishment of roles and competence of each department, which will involve short-term administrative costs. In this system, all issues resulting from the modal activities are monitored by the modal department concerned, and the first-hand proposals of policy measures to those issues are prepared by, in consultation and close coordination with related functional department(s), of the modal department. The initiative to handle inter-modal issues and comprehensive policy formulation and implementation are handled by functional departments.



Note : as of 27 July 1992
Source : MTME

Fig. 2.5.1 Existing Organization of the Ministry of Transport and Maritime Economy

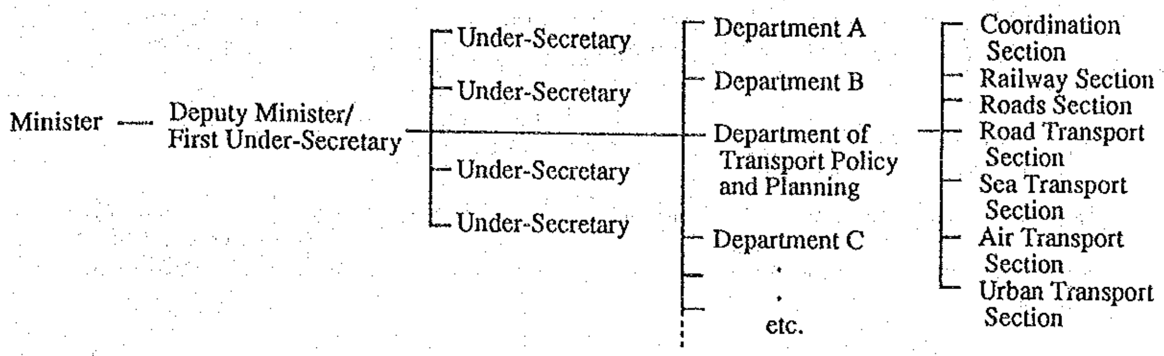


Fig. 2.5.2 Alternative 1: Introduction of Modal Sections to the Department of Transport Policy and Planning

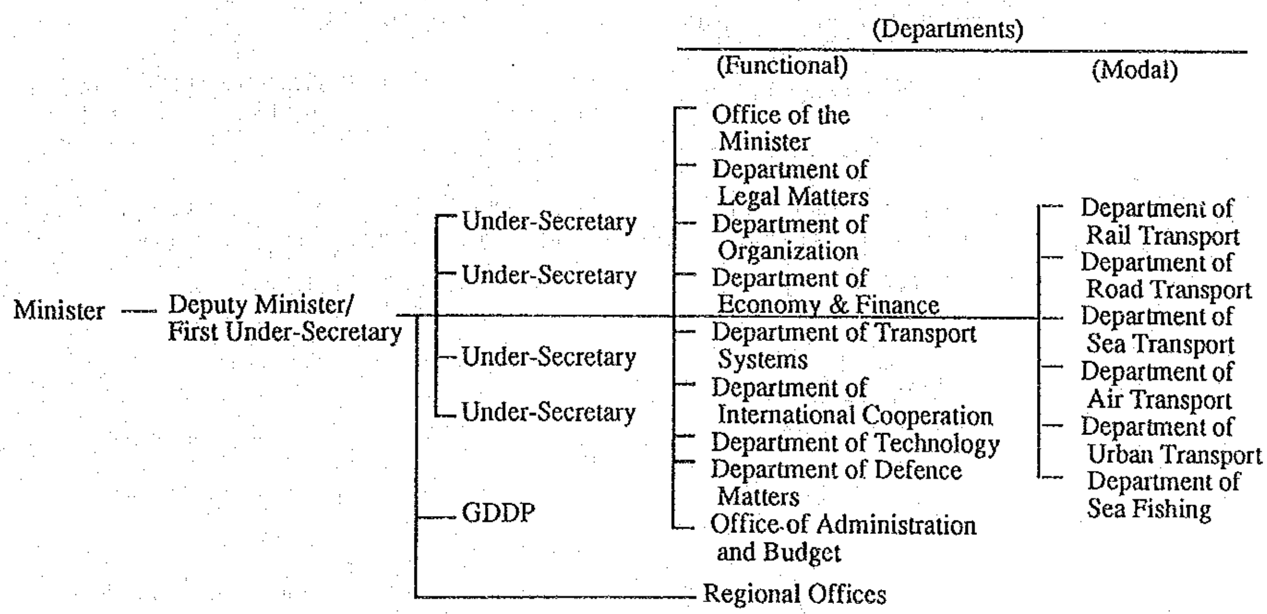


Fig. 2.5.3 Alternative 2: Combination of Functional and Modal Departments

Alternative 1 is the minor adjustment of existing departmental structure. Alternative 1 would be easier to implement, and involves smaller administrative cost of reorganization, but its competence would be short-lived. The size of the Department of Transport Policy and Planning may be improportionately huge compared to other Departments in its number of staff, although it would still not be enough to implement modal administration. In conclusion, Alternative 1 seems to be an insufficient solution to the actual needs of Polish transport administration. The role of the structure of Alternative 1 might be a transitional structure from the existing one to the structure of Alternative 2.

Some additional accounts to the concept of Alternative 2 might be necessary:

- the post of Deputy Minister/First Under-Secretary must be filled, which was vacant as of the end of July 1992, as a function of administrative coordination among leadership of the MTME, while political coordination is to be held by the Minister;

- existing Department of Organization and Supervision could be reorganized to the Department of Organization, since the supervising function would be taken by modal departments;

- Departments of Transport Systems and of Technology might be amalgamated into the Department of Transport Policy and Planning;

- the existing modal Departments of Sea and Inland Waterway Administration and of Shipping and Sea Ports might be handled by a single Department of Sea Transport, which makes it easier to coordinate all issues related to sea transport;

- the existing Department of Land Traffic Administration might be reorganized into the Department of Road Transport and could be relieved from rail-related issues;

- new setup of Departments of Rail Transport and of Urban Transport might be required by taking into account of the ongoing reorganization in the PKP and the future importance of urban transport issues; and

- some functional departments might be amalgamated and could reduce its number since the establishment of modal departments will partly relieve the functions of existing departments.

Annex 1

Transport Statistics Great Britain 1991
- List f Tables and Charts -

Note: Tables marked with an asterisk are either new tables or tables incorporating substantial changes from the 1990 edition.

Part 1 Transport: an overall view

Passenger transport

1.1	Passenger transport by mode	35
1.2	Journeys per person per week: by length and purpose: 1985/86	35
1.3a	Journey per person per week: by purpose and main mode of transport 1985/86	36
1.3b	Distance per person per week:by purpose and main mode of transport: 1985/86	36
1.4	Central London commuter traffic: peak period	37
1.5*	Public transport service quality performance	38
1.6	Overseas travel: visits to and from the United Kingdom	39
1.7	Overseas travel: visits to and from the United Kingdom: by area, purpose and mode: 1990	40
1.8	Overseas travel by air: visits to and from the United Kingdom: by area, purpose and length of stay: 1990	41
1.9	Overseas travel by sea: visits to and from the United Kingdom: by area, purpose, length of stay and type of vehicle on board: 1990	42
1.10	United Kingdom international passenger movement by air and sea: arrivals plus departures: by country of embarkation or landing	44
1.11	United Kingdom international passenger movements by sea and air: by seaport group and airport	46
1.12	Passenger casualty rates by mode	47

Freight transport

1.13	Freight transport by mode	48
1.14	Freight moved: by commodity: 1990	50

Expenditure on transport

1.15	Household expenditure on transport 1979-1989	51
1.16	Passenger transport: consumer cost indices: United Kingdom	52
1.17	Public expenditure on transport: . 1984/85 to 1990/91	53
1.18	Users' expenditure on road and rail transport: United Kingdom	55
1.19	Expenditure on road and rail transport and use of resources: 1990 United Kingdom	56
1.20	Expenditure on inland surface transport subsidies and grants	57
1.21	Regional expenditure on roads: 1989/90	58
1.22	Local authority expenditure on roads: 1989/90	59
1.23	Road construction tender price index	62
1.24	Local authority highway maintenance and lighting: England: price indices	63
1.25	Transport Supplementary Grant: England and Wales: by authority: 1991/92	64
1.26	Grants and subsidies to local bus services	66

Energy

1.27	Energy consumption: by transport mode and source of energy: United Kingdom	67
1.28	Petroleum consumption: by transport mode and fuel type: United Kingdom	68
1.29	Petrol and diesel prices and duties per litre	69
1.30	Index of petrol and oil prices and General Index of Retail Prices	70

Employment

1.31	Employment on transport and communications	71

Trade

1.32	International trade statistics of the United Kingdom	72

Part 2 Road

Road traffic

2.1	Road traffic: by type of vehicle	93
2.2	Road traffic: by type of vehicle and class of road: 1990	93
2.3	Motor vehicle flow: by class of road (average daily 24 hour flow at average point)	94
2.4	Average distance travelled per annum: by class of vehicle	94

2.5 Volume of road traffic: by class of road and type of vehicle 95
2.6 Average daily motor traffic on classified roads: by month and type of vehicle: 1990 96
2.7 Road traffic in Great Britain by vehicle class (chart) 97
2.8 Heavy goods vehicle traffic by axle configuration (chart) 97
2.9 Road motor traffic in Great Britain by road class (chart) 98
2.10 Heavy goods vehicle traffic in Great Britain by road class 1990 (per cent) (chart) 98
2.11 Traffic in Great Britain by road class and vehicle type 1990 (per cent) (chart) 99
2.12 Estimated average daily motor traffic on classified roads by type of day and month (1990 average = 100) (chart) 99
2.13 Average 24 hour flow at selected points on the motorway network: by type of vehicle: 1990 100

Private motoring

2.14 Households with regular use of car(s) 101
2.15 Driving licence holders 102

Driving tests

2.16 Driving tests 103
2.17 Pass rates at first and subsequent test 104
2.18 Distribution of tests by age and sex, and by class of vehicle 105
2.19 Percentage pass rate by age and sex, and by class of vehicle 106
2.20 Faults which led to, or contributed to, failure in group A driving test 107

Motor vehicle registrations and stock

2.21 Vehicles registered for the first time 108
2.22 Vehicles currently licensed 109
2.23 Vehicles registered for the first time: by type of vehicle 110
2.24 Vehicles currently licensed: by taxation class 112
2.25 Vehicles currently licensed: by year of first registration 114
2.26 Vehicles currently licensed: by county 116
2.27 Vehicles currently licensed: by method of propulsion: 1990 118
2.28 Age distribution of stock and vehicle survival rate: cars in all taxation classes 118

Heavy goods vehicles

2.29 Heavy goods vehicles currently licensed 119
2.30 Heavy goods vehicles currently licensed: rigid and articulated 120
2.31 Articulated vehicles currently licensed: 1990 121
2.32 Rigid vehicles currently licensed: 1990 122

Freight transport by road

2.33 Goods lifted by heavy goods vehicles 123
2.34 Goods moved by heavy goods vehicles 124

International road haulage

2.35 International road haulage by United Kingdom registered powered vehicles: goods carried: by country of loading or unloading: 1990 125
2.36 International road haulage by United Kingdom registered powered vehicles: goods carried: by region of loading or unloading: 1990 126
2.37 International road haulage by United Kingdom registered powered vehicles: by type of transport and commodity: 1990 127

Bus and coach industry

2.38 Vehicle kilometres 128
2.39 Passenger journeys 130
2.40 Passenger receipts (including concessionary fares contributions) 131
2.41 Local (stage) bus services: fare indices: by type of operator 132
2.42 Vehicle stock 134
2.43 Staff employed and number of operators 135
2.44 Frequency of local bus use: by age and sex: 1985/86 136
2.45 Percentage of persons who used local buses in the 6 months before interview: by age, sex and number of household cars: 1985/86 137

Taxis

2.46 Vehicles, drivers and fares: England and Wales 138

Forecasts

2.47 Forecasts of road traffic and vehicles: 1995-2025 139

Road network

2.48 Public road length 1990 140
2.49 Defects index of road condition: England and Wales (charts) 143

Road accidents

2.50 Road accident casualties and vehicles involved 146
2.51 Accidents and accident rates: by road class and severity 148

2.52 Casualty rates: by type of road user and severity 149
2.53 Casualties killed or seriously injured: by age of casualty (for certain types of road user) 150
2.54 Breath tests performed on car drivers and motorcycle riders involved in accidents 151

Vehicle safety

2.55 Vehicle testing scheme: (MOT) test results 152
2.56 Road vehicle testing scheme (MOT): vehicle defects: by type 152
2.57 Road passenger service vehicle testing scheme 153
2.58 Heavy road goods vehicle testing scheme 153

Pollution

2.59 Pollutants and greenhouse gases: trends in emissions from road vehicles, railways and other sources: United Kingdom 154
2.60 Pollutants and greenhouse gases from road vehicles: trends in emissions from fuel combustion: United Kingdom 156

Motor vehicle offences

2.61 Findings of guilt at all courts: by type of offence: England and Wales 157
2.62 Fixed penalty notices issued: by type of offence: England and Wales 158
2.63 Written warnings: by offence type: England and Wales 159
2.64 Drinking and driving: summary of breath tests and blood or urine tests: England and Wales 159

Part 3 Rail

British Rail: passenger

3.1 Passenger traffic 164
3.2 Passenger traffic and receipts: by sector 165

British Rail: freight

3.3 Freight receipts: (freight train traffic) 165
3.4 Freight train traffic 166
3.5 Average length of haul (freight train traffic) 167
3.6* Freight tonnes by origin/destination: 1989 168

British Rail: parcels

3.7 Parcels traffic: receipts and tonnes lifted (coaching train traffic) 169

British Rail: operations

3.8 Loaded train kilometres 170

British Rail: staff and assets

3.9 Staff at end of year 171
3.10 Standard gauge railway open for traffic at end of year 171
3.11 Rolling stock at end of year 172
3.12 Stations, depots and sidings open to traffic at end of year 173

British Rail: performance indicators and operating account

3.13 Performance indicators 173
3.14 Operating account (railway operations) 174
3.15 Investment 174

London Regional Transport

3.16 Underground railway passenger traffic 175
3.17 Underground railway operating account 175
3.18 Railway staff at end of year 176
3.19 Railway assets at end of year 176
3.20 Underground railway capital expenditure 177
3.21 Underground railway operations 177

Docklands Light Railway

3.22 Railway operations 178

Strathclyde Passenger Transport Executive

3.23 Railway passenger traffic and assets 178

Tyne and Wear Passenger Transport Executive

3.24 Railway passenger traffic and assets 179

Railway accidents

3.25 Train accidents 179
3.26 Casualties: by type of accident 180
3.27 Passenger casualty rates 181

Part 4 Water transport

Ports

4.1 Foreign, coastwise and one-port traffic 190
4.2 Foreign and domestic unitised traffic 191
4.3 Foreign and domestic traffic, by UK port and port group 192

4.4 Foreign and domestic unitised traffic, by UK port and port group 194

Roll-on/roll-off ferry traffic

4.5 Road goods vehicles outward to mainland Europe: by country of registration 196
4.6 Road goods vehicles outward to mainland Europe: by country of disembarkation 197
4.7 Road goods vehicles outward to mainland Europe: by Great Britain port group 198
4.8 Accompanied passenger vehicles (arrivals and departures) by overseas country: foreign and coastwise routes 199
4.9 Accompanied passenger vehicles (arrivals and departures), by port and port group: foreign and coastwise routes 200

Domestic waterborne freight transport

4.10 Waterborne transport within the United Kingdom 201
4.11 One-port sea-going traffic by area and type 202
4.12 UK coastwise sea-going traffic by port area: goods lifted and moved: 1990 203
4.13 Inland waterway traffic by movement type, mode of appearance and port group: 1990 204
4.14 Map of Great Britain showing rivers and other inland waterway routes used for freight, principal ports and port groups 205
4.15 Traffic on major rivers and other inland waterway routes: 1986-1990 206

Shipping

4.16 United Kingdom and Crown Dependency registered trading vessels of 500 gross tons and over: summary of tonnage by type (end of year) on old and new classifications 207
4.17 United Kingdom and Crown Dependency registered trading vessels of 100 gross tons and over: age and distribution by type of vessel (end of year) 1989/90 208
4.18 United Kingdom and Crown Dependency registered trading vessels of 100 gross tons and over: analysis by deadweight tonnage (dwt) and type of vessel (end of year) 1989/90 209
4.19 International seaborne trade of the United Kingdom: by type of cargo and proportion carried by United Kingdom registered vessels 210
4.20 International seaborne trade of the United Kingdom:analysis by area of consignment and proportion carried by United Kingdom registered vessels 211
4.21 International seaborne trade of the United Kingdom: by flag of carrier 212
4.22 United Kingdom shipping industry: employment of seafarers 212
4.23 United Kingdom shipping industry: revenue from international activities 213

Safety at sea

4.24 HM Coastguard statistics 213
4.25 Marine accident casualties 1985 - 1989 214

Part 5 Air transport

5.1 Traffic at United Kingdom airports by type of service and operator 219
5.2 Main outputs by United Kingdom airlines: by type of service 222
5.3 United Kingdom airline fleet and utilisation 224
5.4 Employment by United Kingdom airlines worldwide 225
5.5 Activity at major airports: 1989 226
5.6 Passenger traffic via major international airlines: 1989 227
5.7 Aviation accident statistics 228
5.8* Punctuality at UK airports 231
5.9* Airmisses: number of incidents 232
5.10* Forecasts of passenger movements at airports in the United Kingdom 233
5.11* Airfreight by country/country area: 1986-1990 234
5.12* Passengers on domestic routes: 1989 238
5,13* International air travel: air passengers by UK airport of arrival/destination and by country of embarkation/landing: 1990 240
5.14* Comparison of international air movements for EC countries: arrivals plus departures: 1989 243

Part 6 International comparisons

6.1 General statistics: 1989 248
6.2 Road and rail infrastructure: 1979 and 1989 249
6.3 Road vehicles: by type: 1979 and 1989 250
6.4* Road traffic by national vehicles on national territory: 1979 and 1989 251
6.5 Road vehicles per head of population: 1979 and 1989 252
6.6* Usage of road infrastructure: 1979 and 1989 253
6.7* Passenger traffic on national territory by national vehicles: 1979 and 1989 254
6.8* Passenger traffic per head of population: by mode: 1979 and 1989 255
6.9* Freight lifted by national vehicles on national territory: 1979 and 1989 256
6.10* Freight moved by national vehicles on national territory: 1979 and 1989 257
6.11 Road deaths: 1980-1989 258
6.12a Petrol and diesel: current retail prices 259
6.12b Petrol and diesel: duty as a percentage of retail prices 259
6.13 Principal fleets by type of vessel and flag: 1979 and 1989 260
6.14 Selected outputs of airlines: 1979 and 1989 261

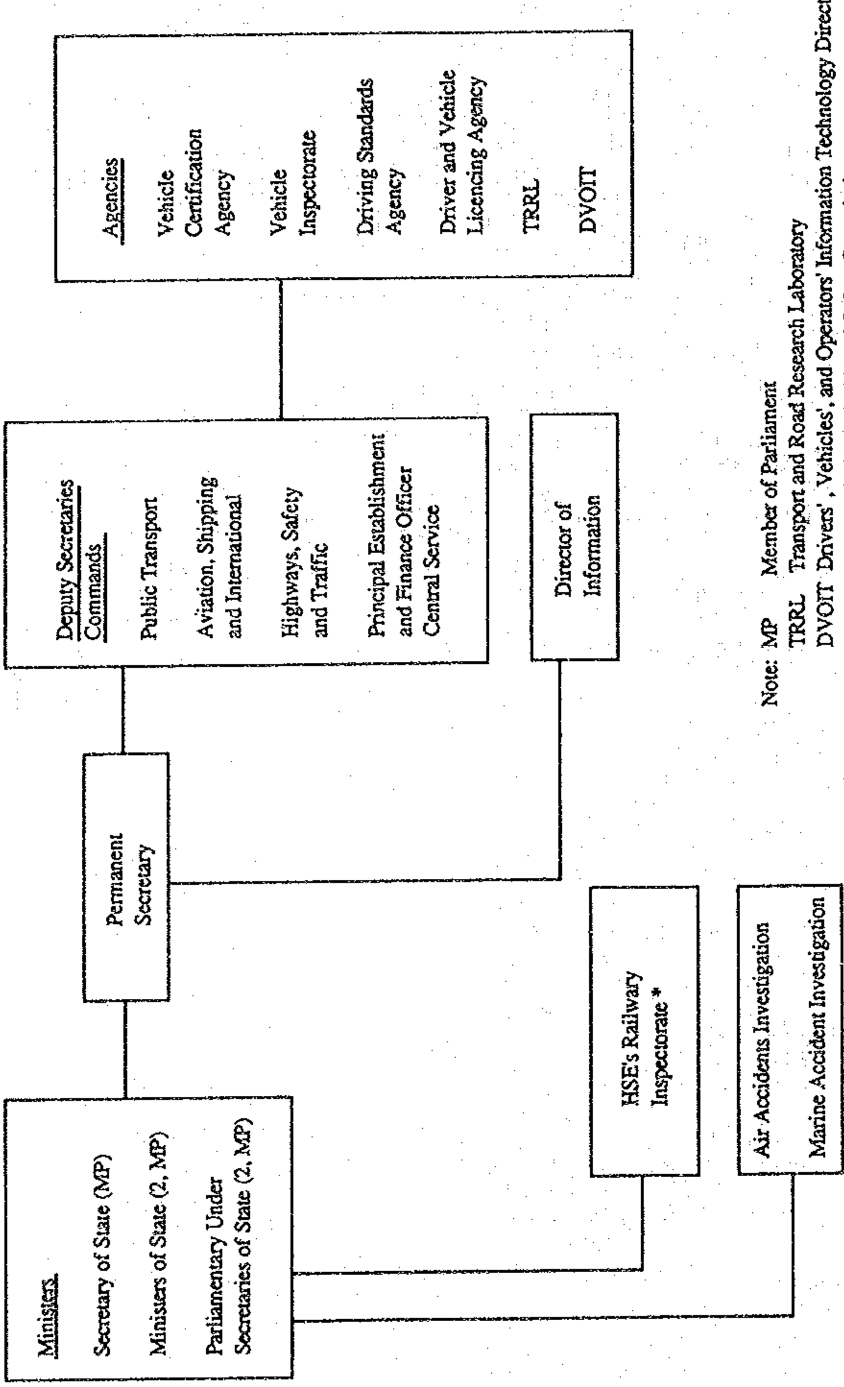
Part 7 Selected historical series

7.1 Passenger transport: by mode: 1952-1979 264
7.2 Households with regular use of car(s): 1951-1979 265

7.3 Freight transport by mode: 1952-1979 266
7.4 Road traffic: by type of vehicle: 1938-1979 267
7.5 Motor vehicles currently licensed: 1903-1979 268
7.6 Motor vehicles registered for the first time: 1951-1979 269
7.7 Road accidents and casualties: 1927-1979 270
7.8 British Rail: passenger and freight traffic: 1919-1979 271
7.9 British Rail: investment 272
7.10 British Rail: length of route 273
7.11 London Transport underground railway: passenger traffic: 1935-1979 274
7.12 United Kingdom merchant vessels of 500 gross tons and over: end of year: 1950-1979 275
7.13 All ports of Great Britain, foreign, coastwise and one-port traffic: 1965-1979 276
7.14 Activity at civil aerodromes: United Kingdom: 1950-1979 277
7.15 Road lengths: Great Britain: 1909-1979 278

Annex 2 Organization Charts of Ministry of Transport

Annex 2-1 Organization of The Department of Transport in The United Kingdom



Note: MP Member of Parliament
TRRL Transport and Road Research Laboratory
DVOIT Drivers', Vehicles', and Operators' Information Technology Directorate
* On behalf of the Health and Safety Commission

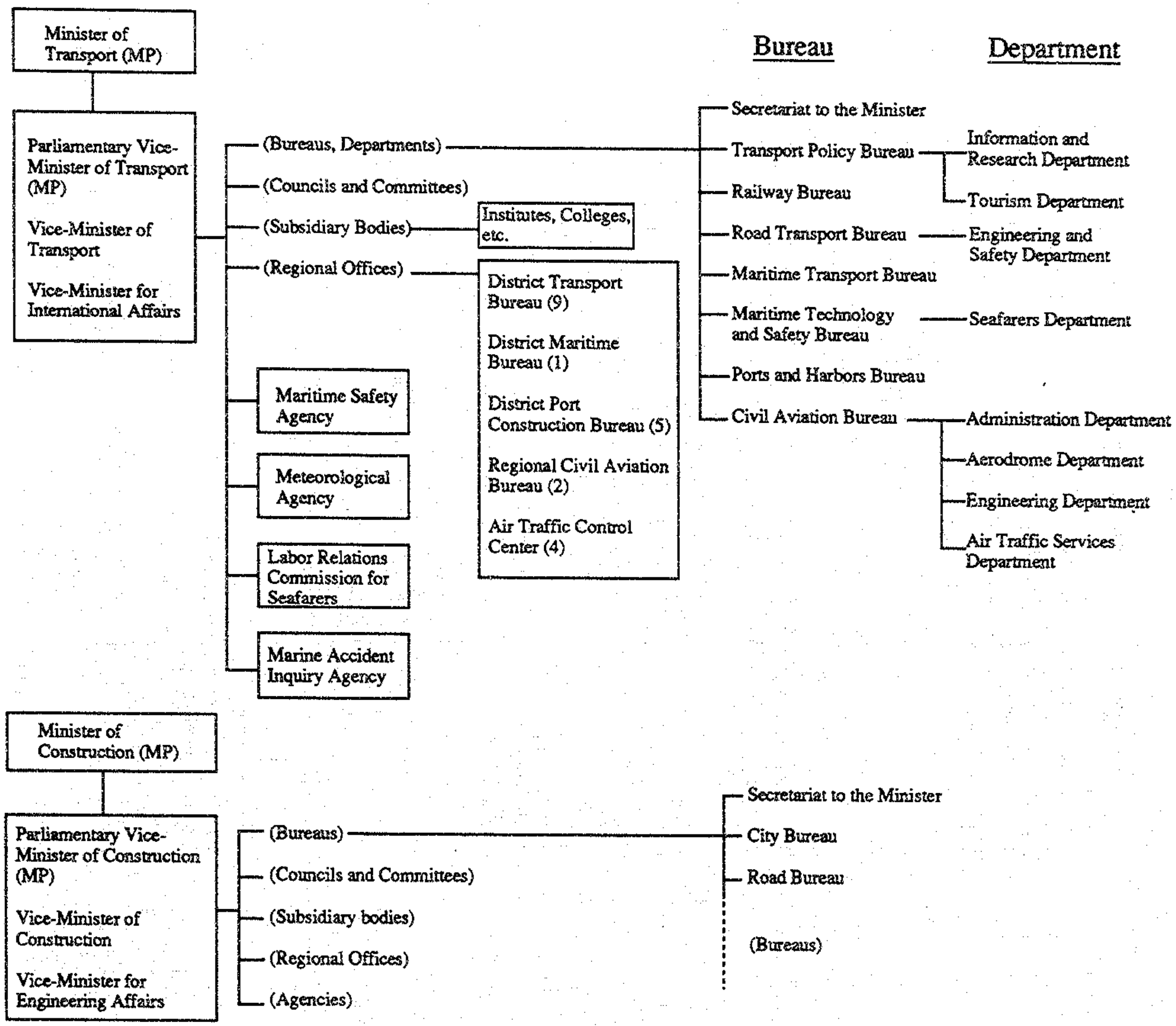
Source: Department of Transport, UK.

Annex 2-2 Organization of The Department of Transport in The United Kingdom (Command-Directorate Level)

Command	Directorate
Deputy Secretary (Public Transport)	Railway I Directorate
	Railway II Directorate
	Urban and General Directorate
	Public Transport London Directorate
	Chief Scientist's Unit
Deputy Secretary (Aviation, Shipping and Internationl)	Shipping Policy, Emergence and Security Directorate
	Marine Directorate
	Civil Aviation Policy Directorate
	International Aviation Directorate
	International and Freight Directorate
Deputy Secretary (Highways, Safety and Traffic)	Engineering Policy
	Network Management and Maintenance
	Highway Policy and Resources
	Road Programme Directorate — Regional Construction Programme Divisions (8)
	London Regional Directorate
	Road and Vehicle Safety
Deputy Secretary (Central Services)	Personal Management
	Finance
	Economics (Transport)
	Statistics

Source : Civil Service Yearbook, 1991.

Annex 2-3 Organization of Ministries of Transport and of Construction in Japan



CHAPTER 3 PRE F/S ON THE IMPROVEMENT OF CMK RAILWAY LINE

CHAPTER 3 PRE F/S ON THE IMPROVEMENT OF CMK RAILWAY LINE

Summary

1) Introduction

The PKP has been making efforts to introduce high speed passenger transport service network between major cities in Poland. The CMK (Central Trunk Railway) was constructed in 1977 connecting Warsaw and Katowice/Krakow with a length of about 300 km. At present, the PKP offers high speed passenger train service on the line at a maximum speed of 160 km/h, although the alignment of the line allows a high speed train operation at a maximum speed of more than 250 km/h. So, this study examined the technological, economic and financial possibility of high speed train operation on the line, considering future roles of PKP in the liberalized transport market together with the future direction of Poland to join the international railway networks.

2) Options Evaluated

Four options were studied against the "without improvement" situation:

Option 1: The maximum train speed is kept at 160 km/h, while total travel time is reduced by easing present speed restriction sections. Frequency of the service is to be improved significantly as well.

Option 2: The maximum train speed is assumed at 200 km/h. Rolling stock for this option were assumed to be manufactured in Poland.

Option 3: The maximum train speed is assumed at 250 km/h. An EMU trains equivalent to Japanese Shinkansen 300 series was assumed.

Option 4: The maximum train speed is assumed at 200 km/h. The difference with the option 2 is rolling stocks, which are to be imported.

3) Traffic Demand

Future patronage of the CMK line was estimated based on the existing Origin-Destination tables and the future level of service by the options by taking account of the competing modes of buses and sedans. The resulting future railway patronage on the line is shown in Table 1.

Table 1 Future Daily CMK line Patronage

Year	Without Improvement	Option 1	Option 2	Option 3
1998	14,913	16,392	18,060	19,000
2000	16,614	18,262	20,121	21,166

Note: Option 4 is same as Option 2

4) Technical Considerations

- Traffic operation and rolling stocks

  Based on the future patronage of the line, necessary number of service is calculated as 52 for all options. Necessary number of train set was 19, 15 and 15 for option 1, 2 and 3 respectively. Time between train arrival and departure is assumed to be reduced by improvements of terminal station's facility. So, necessary number of train sets is less than the existing one.

- Track and structures

  Existing track renewal was assumed to continue. In the case of option 2 and 3, turnouts should be replaced by movable nose crossings. Level crossings should be eliminated by the commencement of the high speed operation. Fences should be installed to prevent various accidents for option 2 and 3. Near Katowice, there are many speed restriction sections due to old coal mine collapse. The restriction is to be eased by installing suitable alarm system.

- Overhead Contact Wire Equipment

  Contact wires should be replaced for the option 3 operation.

- Traction substation

  Inverters should be installed at some substations to absorb regenerated energy by regenerative braking system in Options 2 and 3. A set of rectifier should be installed in Option 3.

- Signaling and telecommunication

  In the case of option 2, an automatic block with 5 aspect signals is assumed together with improved Automatic Train Protection System. Automatic Train Control System or a continuous cab signal with ATP should be installed for option 3. Optical fiber information network which is under construction by PKP is assumed for all options including the "without improvement" case.

5) Cost estimates and implementation plan

Total initial investment cost of the project by option is shown in Table 2 together with the "without improvement" case.

Inauguration of commercial operation is assumed in 1998, after the feasibility study (1993), detailed design (1994), improvement works and rolling stock manufacturing (1995-1997).

Table 2 Investment Cost of the Project

Option	Cost (Million zl.)
Without Improvement	1,949,467
Option 1	1,723,367
Option 2	2,967,024
Option 3	5,554,486
Option 4	3,829,824

Note 1: Costs for designing, supervising and contingency are not included.
2: Option 1 is less than the "Without Improvement" case because of the option needs less investment for rolling stock by the improved operation.

6) Project Evaluation

Option 1 needs fewer investments and generates benefits compared with the "without improvement" case. Needles to say, the option should be executed as soon as possible.

The EIRR of the option 2 is calculated at 18.8%. This value is considered very high and the EIRR is 12.1% even when the cost increase by 20% in taken into account. The FIRR of the option is 5.83% under the existing passenger fare level. However, if the discount tickets are abolished, the FIRR becomes 9.4% if the number of passengers remain unchanged. Option 2 is considered feasible from the results of the economic and financial analyses. The discount tickets are recommended to be abolished to secure financial viability.

Option 3 and 4 are evaluated not viable. The cost of rolling stock, which are the major cost of these options, are too expensive to make the options viable.

3.1 Introduction

3.1.1 General Conditions of the CMK Corridor

CMK is an abbreviation of Centralna Magistrala Kolejowa, which means central railway trunk line. The CMK connects Warszawa and Katowice/Krakow area as shown in Fig. 3.1.1. Total length of the line is about 300 km.

There are two railway lines parallel to the CMK line. The one connects Warszawa and Katowice via Czestochowa. The other line connects Warszawa and Krakow via Radom and Kielce. National roads No. 8 (E67) and No. 1 (E75) connects the ares via Lodz and Czestochowa. National road No. 7 (E77) connects the areas via Radom and Kielce as well. Therefore, this route can be said as CMK corridor consisting of the three railway lines and the two national roads.

The biggest metropolitan areas and cities in Poland locate along the corridor. Warszawa is the capital city of Poland with 1.7 million population. Katowice, which locates at the other end of the corridor, forms the biggest metropolitan area in Poland with 2.7 million population. Lodz, which is the third biggest metropolitan area with 1 million population, locates along the corridor. Krakow which is the fifth with 748 thousand population, Czestochowa (267 thousand), Radom (226 thousand) and Kielce (213 thousand) locate along the corridor, as well.

Population density of the voivodships along the corridor is also high. The density of Warszawa, Lodz and Katowice is more than 500 people per square km, followed by krakow of more than 300 people per square km. These voivodships are the most densely populated areas in Poland.

Regarding industrial production, the corridor has the biggest industrial areas as well. Katowice and Krakow area is the biggest industrial area in Poland with heavy industries and fuel and energy industries. The area produces coal and metals. Warszawa is the second biggest industrial area with heavy industries and food industries. Lodz is also an industrial area of textile and machinery industries, while Radom and Kielce concentrate on machinery industries.

Therefore, the CMK corridor can be said as the most populated and industrialized area in Poland.

However, the CMK line passes rather less populated areas in the corridor. Opoczn and Wloszczowa are big cities along the line with populations of 21,000 and 10,700, respectively. So, although 10 intermediate stations exist on CMK, all of them are placed for operational purposes and none of them has a platform for passengers. Major purpose of the CMK line is to connect the biggest two areas of Warszawa and Katowice/Krakow by high speed train service.

As to natural conditions of the corridor, Warszawa is located approximately 90 m above sea level and the section between Warszawa and Zawiercie is hilly terrain approximately 300 m above sea level. The maximum gradients at the southern section is 6 per 1,000. Average minimum monthly temperature during 1981-90 along the CMK was -16.8 degrees C. The maximum monthly rainfall during 1981-90 was 165 mm, and the maximum number of days with snowfall was 68 days.

3.1.2 Feature of CMK and its Roles

1) History of CMK

CMK was constructed from Grodzisk maz. in the suburbs of Warszawa to Zawiercie on the outskirts of Katowice from 1971 to 1977 for a total length of 224 km (Fig. 3.1.2). The line was constructed as a modern, electrified one servicing long distance high-speed passenger transport and heavy freight transport without making any intermediate stops.

The following technical parameters for the construction were adopted:

- The maximum speed of passenger trains was to be 200 to 250 km/h/
- The weight of freight trains was to be up to 5,000 gross tons.
- The minimum curvature radius was to be 4,000 m.
- The maximum gradient was to be 6 per 1,000.
- Welded rails weighing 60 kg/m with 1,733 hard wooden sleepers per km were to be used.
- Crushed stone ballast 30 cm thickness was to be placed under the sleepers.
- Electrification system was direct current 3 kv same as other electrified lines of PKP.

After the construction, CMK was used for heavy freight transport for some years because of the large demand and insufficient capacity of other lines at the time.

Passenger express trains with a maximum speed of 160 km/h started to run from Warszawa to Katowice and Krakow recently. Although the number of the trains at this speed was limited, it is worth mentioning that this first example of high-speed operation in Poland was accomplished using domestic products.

In 1992, a new time table was published. PKP has improved intercity passenger transport remarkably particularly on the CMK Line. Most of the CMK passenger trains has their operational speed raised to 160 km/h. On the other hand, most of the heavy freight trains on CMK were transferred to other parallel lines.

2) Features of CMK and its Future Roles

Features of CMK can be summarized as follows:

(1) CMK connects the capital of Poland and her most populated and industrial area over a distance of 300 km.

(2) CMK is a part of north-south axis of transport through eastern Europe, and assigned as an important international railway line of AGC and AGTC.

(3) Alignment of CMK adopts high-speed operation of up to 250 km/h or more.

(4) Besides CMK, there are two parallel lines along the corridor. Both lines pass through populated area but can not handle high-speed operation because of their alignments.

According to recent practices of high speed operation, the mixed operation of high-speed and bulky freight trains is not considered advantageous on this line. Transfer of heavy freight trains to parallel lines, which was realized by PKP recently, will be necessary.

Future roles of CMK will be:

(1) Intercity passenger transport connecting the capital and major industrial area

(2) Long distance passenger transport as a part of north-south axis of Poland and eastern Europe.

(3) Fast freight transport including intermodal transport on the north-south axis depending on demand.

Considering future roles of CMK, the major goal of the project is to concentrate on intercity passenger transport. At present, there is no particular demand for fast freight transport on CMK.

It is essential to streamline CMK and to put emphasis on reducing cost in the course of improvement, to cope with PKP's difficult financial situation and future competition with other transport modes.

The exact section of CMK is the section between Grodzisk Maz. and Zawiercie (see Fig. 3.1.2). However, since the major goal of this project is the intercity transport between Warszawa and Katowice/Krakow, all the sections including Warszawa - Grodzisk Maz., Zawiercie - Katowice and Psay - Krakow are included in the study.

3.1.3 Basic Improvement Policies and Proposed Alternatives

1) Selection of the Maximum Speeds

CMK's alignment, with a minimum curvature radius of 4,000m and a maximum gradient of 6 per 1,000, will technically enable maximum train speed of up to 250 km/h or more. However, the output of motive power for high-speed railways increases almost proportionally to the cube of the speed, which makes the cost of these trains expensive. In the case of Warszawa - Katowice and Warszawa - Krakow line, maximum speed can only be applied on the sections of 220km and 170km respectively out of a total length of 300km.

Given the above background, three alternatives of 250km/h, 200km/h and 160km/h were selected in terms of maximum speed.

2) Proposed Alternatives

The following four alternatives, excluding the "without case" where no improvements are made, are taken up in carrying out the technical as well as economic and financial study.

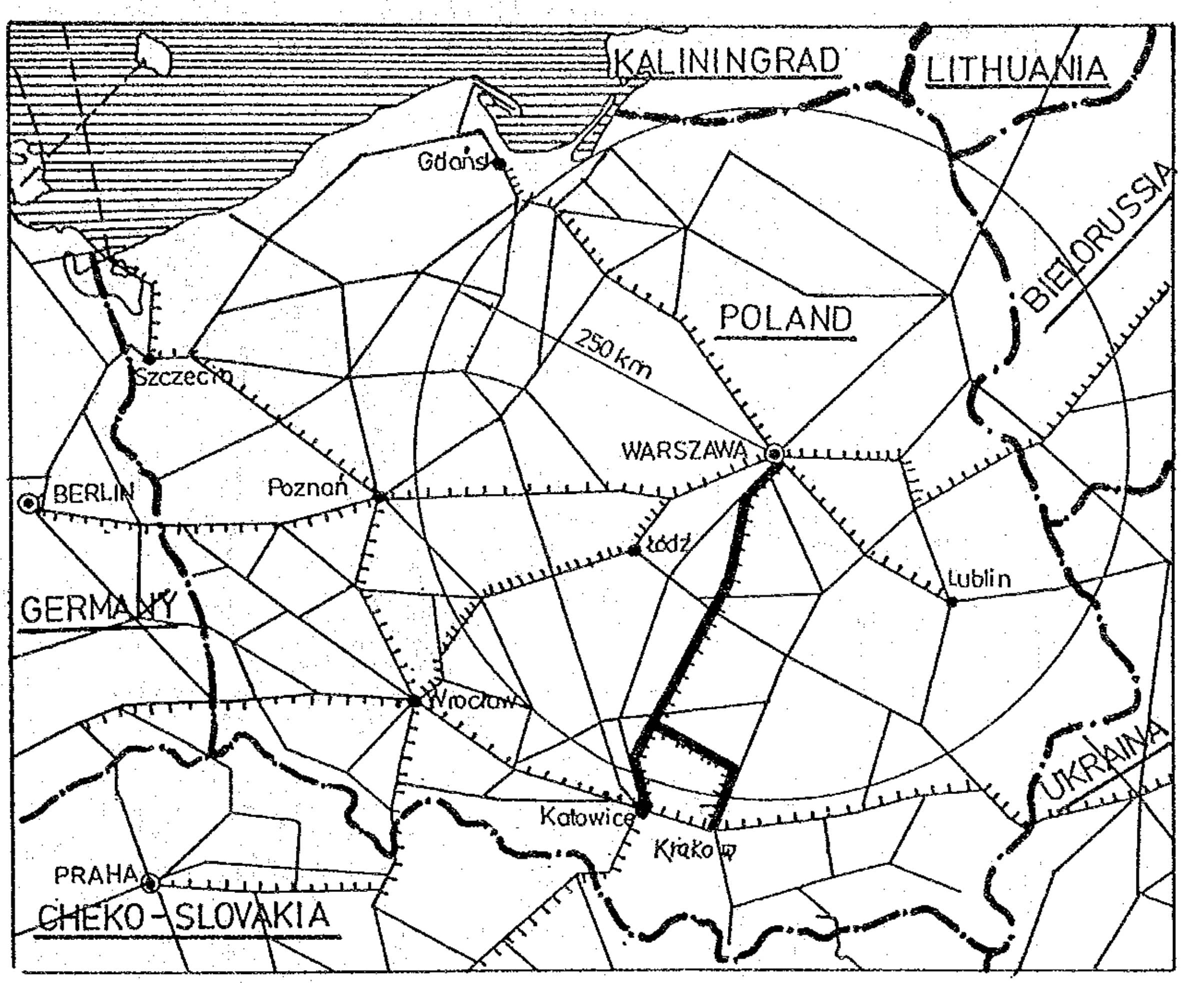


Fig. 3.1.1 Situation of CMK in Poland

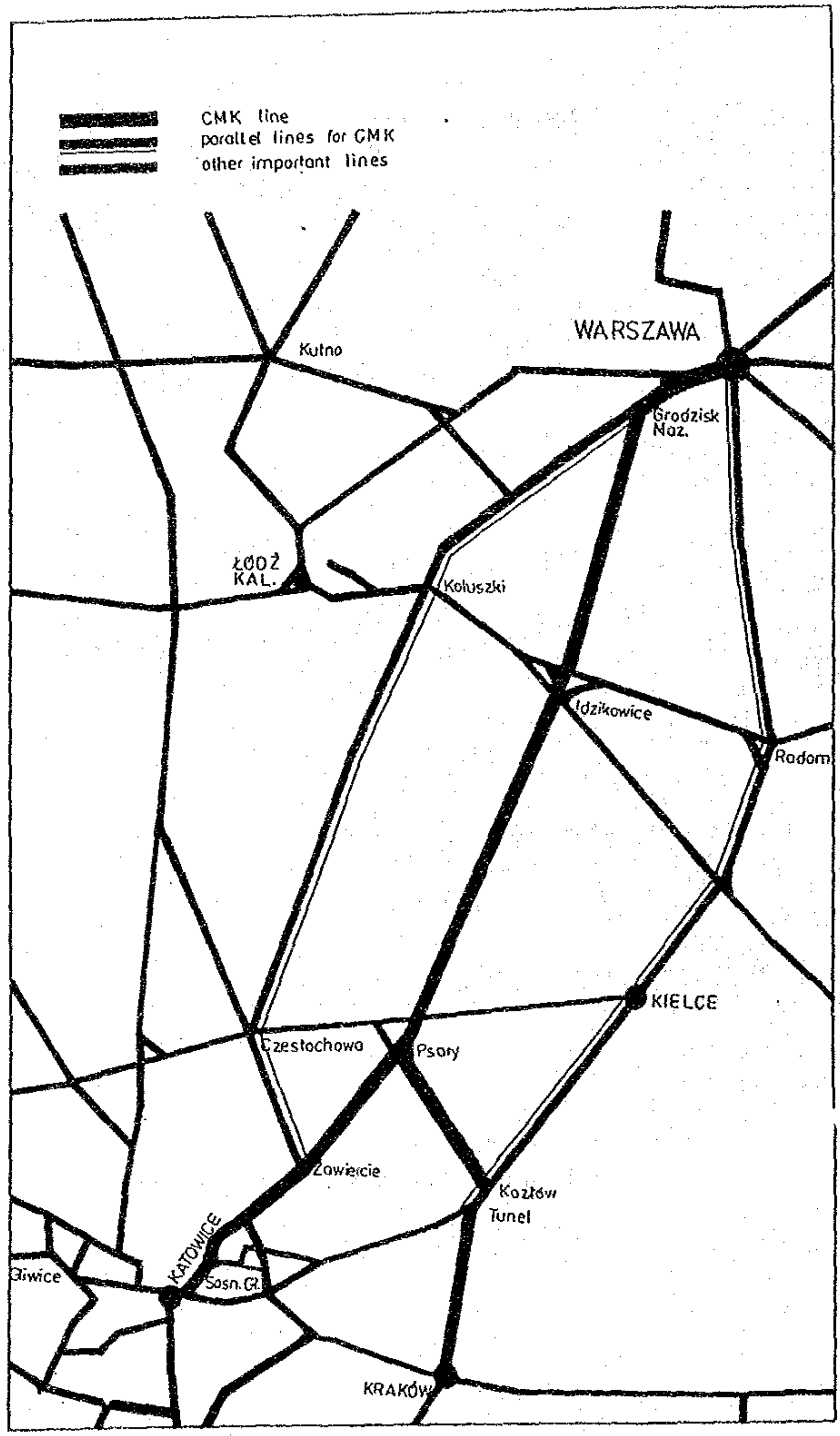


Fig. 3.1.2 Railway Network in the CMK Corridor

(1) Improved 160 km/h Case (Option 1)

Maximum speed is kept at 160 km/h, the same as at present. However, total travelling times are to be improved by easing present speed restrictions as much as possible. Frequency of trains will also be increased, so there will be at least one round trip train for every hour for both sections of Warszawa - Katowice and Warszawa - Krakow. On the other hand, costs must be reduced as much as possible. For example, the time between the arrival and departure of a train at each terminal station has to be reduced to within around 30 minutes by improving terminal stations, as compared with the present 2 to 3 hours. This will improve the availability of rolling stock remarkably. It is assumed that the present electric locomotive, EP09 (BoBo 2,920 kw 82 t) and passenger coaches (average weight 42 t, maximum number 14, total weight 588 t) will consitute a train formation.

(2) 200 km/h Case (Option 2 and 4)

Considering that many of the trains on CMK are long distance international trains which were manufactured in Poland, it is assumed that conventional trains consist of locomotive and standard passenger coaches.

An electric locomotive (BoBo 5,400 kw 80 t) with VVVF controlled AC induction motors was assumed to be able to run at 200 km/h hauling 14 passenger coaches (588 t) on CMK. 200 km/h was deemed to be the nominal speed and the allowable safety limit was set at 210 km/h.

Option 2 represents a case which adopts rolling stock manufactured in Poland, while Option 4 assumes that PKP uses imported rolling stocks.

(3) 250 km/h Case (Option 3)

Current world practice shows that for a train to travel at 250 km/h or more it needs to be a EMU train set or a push-pull train with motive power at both ends, because a single locomotive does not have enough output to haul a number of passenger coaches at high speed.

An EMU train similar to Japanese Shinkansen 300 series was assumed to consist of 6M6T (6 motor cars and 6 trailers), VVVF controlled AC motor driven, with 7,800 kw output weighing 576 t.

250 km/h was deemed to be the nominal speed and the allowable safety limit was defined as 260 km/h.

3) Streamlining CMK by Transferring General Freight Trains

There are 10 intermediate stations on CMK, with a locomotive depot and a freight wagon depot at Idzikowice. Number of on-site staffs between Grodzisk and Zawiercie (excluding Grodzisk and Zawiercie) are as follows.

Stations	Administration	25	
	Traffic officers	94	
	Maintenance of switches	58	
	Others	54	
	Total		231

Locomotive depot	Administration	48	
	Drivers	270	
	Workshop	582	
	Total		990
Wagon dept.	Administration	15	
	Inspection	63	
	Workshop	115	
	Total		193
Signaling and telecommunication			260
	Grand Total		1,584

The majority of the freight trains on CMK have been already transferred to parallel lines. This should be completed as a course of improvement of CMK. The transfer of general freight trains will have the following merits.

(1) The staff at the locomotive depot and the wagon depot can be utilized for other purposes.

(2) The number of intermediate stations can be reduced and the track layout of stations, can be remarkably simplified. This will reduce the costs of switches for high speed operation.

(3) To actually use CTC (Centralized Traffic Control), the present relays for the interlocking have to be changed to increase reliability.

The above-mentioned simplification of station track layout will result in large savings in changing the relays. CTC will also reduce the need for a large number of station staffs.

Although the total costs saved by this transfer will be considerable, this is not included in the economic and financial evaluations.

3.2 Traffic Demand Forecast

This section discusses the techniques, methodologies and findings of processes employed in estimating future rail ridership in the CMK corridor.

3.2.1 Conceptual Synopsis

The realization of high-speed service in the CMK corridor represents an exiting new epoch for the PKP, and the successful implementation of such a project is likely to profoundly impact transport utilization patterns in the Warsaw - Katowice - Krakow axis. Ample precedence exists regarding experience of high-speed rail projects. For example, the Tokaido Shinkansen service in Japan experienced, after an initial acclimatization period by the public, a rapid growth in ridership until, in its tenth year of operation, patronage was almost double of that forecast. Furthermore, TGV service in France has realized strong growth in ridership, all at a time when passengers on standard trains have been steadily declining. The Southeast Paris - Lyon TGV line for example, has enhanced its ridership base to the point that Paris - Lyon air traffic activity has declined, and A6 motorway traffic grown at noticeable reduced rates relative to other geographic corridors.

The CMK project is not, in all fairness, a Shinkansen or a TGV. Nevertheless, alternative improvements in service are proposed which will raise maximum train operating speed to either 160km/h 200km/h, or 250km/h. Thus, a Warsaw - Katowice journey, which requires 165 minutes at present (1992 CMK intercity express), would be reduced to as little as 121 minutes in future.

The likelihood of additional ridership being drawn to the rail mode as a result of significant service improvements can be viewed from two perspectives. The first approach, which is typically used in planning analyses, accepts that ridership is likely to increase as service time decreases. The second approach, which is much more difficult to quantify, supposes that additional demand can be generated as consumer attitudes gradually change to "por rail', possibly fueled by enhanced amenities (such as clean stations, efficient booking services, and modern rolling stock) or, alternatively, negative perceptions of competing modes. The second approach is, in general terms, already incorporated into procedures utilized to estimate future system-wide PKP ridership. Thus, the first approach, namely, that rail passengers will grow in response to faster service, is used to estimate additional CMK riders. The elasticity which underlies this approach is drawn from European and Japanese rail operations experience, and suggests that the number of trips will grow at slightly less than unity relative to decreases in total trip time.

3.2.2 Overview

It is estimated that national rail ridership will continue suffering losses in the immediate future, but will achieve modest, if steady, gains during the post-1995 period. These projections, compared to actual 1990 and 1991 patronage, are:

Year	Annual Passengers (Mln)
1990	789.9
1991	661.0
1995	612.1
2000	658.5
2005	707.4

These forecasts are based on a gradual transition of Polish modal choice toward European norms, and a consistently positive organizational strategy by PKP which would, for example, entail good maintenance and conversion to a market-responsive entity, but exclude major improvement projects such as that proposed for the CMK line. Thus, the projected annual rail ridership, and person trip matrixes which underlie these projections, can be viewed as the unimproved (relative to CMK line) case..

The CMK improvement is, essentially, provision of non-stop Warsaw - Krakow and Warsaw - Katowice services, with alternative proposed maximum train operating speeds of 160 km/h, 200 km/h or 250 km/h. A comparison to current (unimproved) CMK express intercity services yields Table 3.2.1.

Table 3.2.1 Comparison of Trip Time

Option		Warsaw - Katowice		Warsaw - Krakow	
		Trip time (Min)	Avg. Trip Speed (km/h)	Trip Time (min)	Avg. Trip Speed (km/h)
Unimproved		165	108.4	155	113.4
Option 1	160 km/h	155	115.4	145	121.2
Option 2	200 km/h	135	132.4	125	140.6
Option 3	250 km	121	147.8	120	146.5

Note: Indicated time and speed are for station - station operation and excludes station access/egress or waiting times.

Thus, the primary patronage catchment for CMK service includes the Warsaw - Krakow - Katowice triangle, with secondary catchments extending as far as Gdansk/Gdynia, Olsztyn and Bialystok in the North, as well as CSFR frontier crossings in the South (Figure 3.2.1).

The modal demand for rail (CMK plus other corridors and road (sedan plus bus) person trips for each of the studies' two analysis years, between North and South areas of the catchment, are estimated (Table 3.2.2).

Table 3.2.2 Daily Person Trips

(000)

Year(1)	Rail	Road	Percent Rail
1998	21,920	43,892	33.3
2005	24,416	59,824	29.0

Note: (1) 1998 data was derived via an interpolation of previously developed 1998 and 2000 matrixes.

Thus, with continued improvement including a responsive free-market orientation, the absolute number of rail trips in all corridors linking North - South areas of the CMK patronage catchment are expected to increase-however, the relative share vis-a vis the road mode will probably decline. The CMK line improvement represents an excellent opportunity with which to recover lost modal share from competing modes of transport.

3.2.3 Ridership Implications

The total rail ridership between North - South districts of the patronage catchment is, expected to total some 21,900 and 24,400 persons in 1998 and 2005, respectively. However, not all will utilize the CMK line. For example Gdansk/Gdynia - Katowice travel can be accomplished via Bydgoszc, and indeed, Warsaw - Katowice travel via Piotrkow Tryb. and Warsaw - Krakow travel via Radom. Travel via competing corridors is, in some instances faster or cheaper than travel via the CMK corridor. Removal of traffic diverted to competing lines, and comparison to existing data, suggests that CMK line utilization (unimproved condition) totals 16,600 passengers (Table 3.2.3).

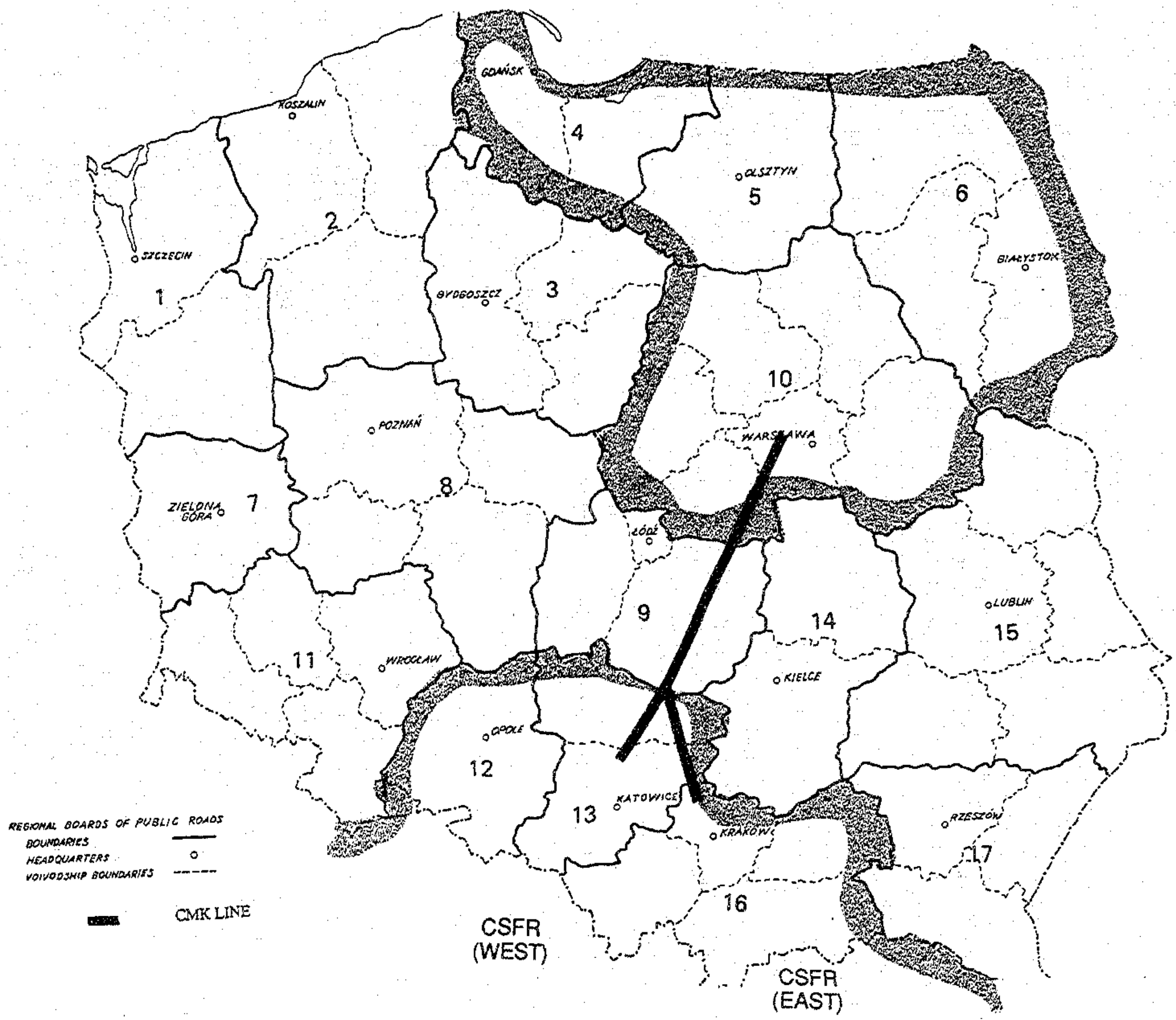


Fig. 3.2.1 Potential Patronage Catchment of CMK Line Services

Table 3.2.3 Daily Two-way Passengers (unimproved condition)

Year	Daily Two-way Passengers
1992	14,300
1998	14,900
2005	16,600

Additional patronage to the CMK line catalyzed by faster and more frequent CMK corridor service is estimated, as indicated earlier, by the ratio of pre-and post-improvement total trip time raised to a slightly less than unity exponent (0.9). Trip time includes total time from origin to destination. Thus, a Bialystok - Katowice trip via the CMK line encompasses station access time in Bialystok, wait time at Bialystok station, travel time to Warsaw station, transfer/wait time at Warsaw station, travel time via CMK line to Katowice station and station egress time in Katowice. Thus, the total time of any trip will only be decreased as a result of faster and more frequent CMK line service. This impact varies by origin-destination grouping. Trips within the principal ridership catchment (the Warsaw - Katowice - Krakow triangle), where CMK line travel time represents the highest proportion of total trip time, will decrease by some 8, 16, and 20 percent for improvement options 1, 2 and 3 (maximum operating speed = 160, 200 and 250 kilometers per hour, respectively). Other interchanges involve transfer activity: thus, the impact of CMK line upgrading on total trip time will be less pronounced; for example, trip time between Olsztyn and Krakow will increase by a modest 5, 9 and 10 percent for CMK improvement options 1, 2 and 3 (Table 3.2.4).

Table 3.2.4 Travel Time Difference by Option

(Minutes)

District	Option	13	16	CSFR (EAST)	CSFR (WEST)
4	Unimproved	598.1	578.3	876.3	705.3
	Option 1	573.1	553.3	846.3	675.3
	Option 2	553.1	533.3	826.3	655.3
	Option 3	539.1	528.3	821.3	641.3
5	Unimproved	512.1	492.3	790.3	619.3
	Option 1	487.1	467.3	760.3	589.3
	Option 2	467.1	447.3	740.3	569.3
	Option 3	453.1	442.3	735.3	555.3
6	Unimproved	456.9	437.1	735.1	564.1
	Option 1	431.9	412.2	705.1	534.1
	Option 2	411.9	392.1	685.1	514.1
	Option 3	397.9	387.1	680.1	500.1
10	Unimproved	253.1	233.3	521.3	350.3
	Option 1	233.1	213.3	501.3	330.3
	Option 2	213.1	193.3	481.3	310.3
	Option 3	199.1	188.3	476.3	296.3

Note 1) Refer Fig. 3.2.1 for district identification
2) Trip time includes station access/egress time, station wait time, travel time and transfer/wait time, if any.
Travel time external to CMK corridor based on current fast/express train service; within CMK corridor on current and proposed (refer 3.3) express train service. Average wait time at stations external to

CMK corridor = 30 minutes; within CMK corridor 30 minutes (unimproved) and 20 minutes (improved).
Average transfer/wait time/penalty in CMK corridor = 40 minutes (unimproved) and 30 minutes (improved).

CMK line ridership is, based on stated elasticities and time differences, expected to increase for each CMK improvement option (Tables 3.2.6 ~ 3.2.9). In summary:

Table 3.2.5 Projected Number of Passengers of CMK

Year	Unimproved Condition	Improved Condition		
		Option 1: 160 km/h	Option 2: 200 km/h	Option 3: 250 km/
1992				
Daily Trips	14,313			
1998				
Daily Trips	14,913	16,392	18,060	19,000
Trips increase		1,479	3,147	4,087
Increase %		9.9	21.1	27.4
2005				
Daily Trips	16,614	18,262	20,121	21,166
Trip increase		1,648	3,507	1,552
Increase %		9.9	21.1	27.4

Thus, improving maximum CMK train speed to 160 kilometers per hour will increase ridership by about 10 percent over the unimproved condition. Options 2 and 3 (maximum speed = 200 km/h and 250 km/h) are expected to catalyze 21 and 27 percent increase over the unimproved condition.

The growth in trips on a district bases will vary, as implied by the review of trip times between catchment districts. For 2005 conditions, for example, trips between Warsaw and Katowice (districts 10 and 13) are forecast to grow by 11, 24 and 34 percent over the unimproved condition for options 1, 2 and 3, respectively. In contrast, trips between Olsztyn and Krakow (districts 5 and 16) will grow by a more modest 7,13 and 14 percent (Table 3.2.10). The Warsaw - Katowice - Krakow triangle is, as expected, likely to furnish about two-thirds of total trips using the CMK line, with that relative proportion increasing slightly among improvement options.

Table 3.2.6 Projected CMK Ridership: Unimproved Case
(Daily two-way)

District	Year	13	16	CSFR (EAST)	CSFR (WEST)
4	1998	1,005	1,060	21	269
	2005	1,120	1,179	24	298
5	1998	211	130	14	120
	2005	234	146	15	133
6	1998	379	137	0	18
	2005	424	153	0	21
10	1998	4,915	4,711	190	1,733
	2005	5,475	5,251	213	1,928

Table 3.2.7 Projected CMK Ridership: Option 1 (160 km/h)

(Daily two-way)

District	Year	13	16	CSFR (EAST)	CSFR (WEST)
	1998	1,085	1,121	22	284
4	2005	1,209	1,247	25	315
	1998	225	139	15	128
5	2005	249	156	16	142
	1998	407	128	0	19
6	2005	455	165	0	23
	1998	5,455	5,276	200	1,868
10	2005	6,077	5,881	224	2,078

Table 3.2.8 Projected CMK Ridership: Option 2 (200 km/h)

(Daily two-way)

District	Year	13	16	CSFR (EAST)	CSFR (WEST)
	1998	1,154	1,175	23	295
4	2005	1,286	1,306	26	327
	1998	237	147	15	134
5	2005	263	165	16	148
	1998	432	157	0	20
6	2005	483	175	0	24
	1998	6,091	5,952	210	2,018
10	2005	6,785	6,635	236	2,246

Table 3.2.9 Projected CMK Ridership: Option 3 (250 km/h)

(Daily two-way)

District	Year	13	16	CSFR (EAST)	CSFR (WEST)
	1998	1,206	1,188	23	303
4	2005	1,344	1,322	26	336
	1998	246	149	15	138
5	2005	273	167	16	153
	1998	451	160	0	21
6	2005	504	178	0	24
	1998	6,608	6,143	213	2,136
10	2005	7,361	6,847	239	2,376

Table 3.2.10 Ratio of Ridership, Improved Versus Unimproved Conditions in 2005

District/	Option	13	16	CSFR (EAST)	CSFR (WEST)
4	option 1	1.08	1.06	1.04	1.06
	option 2	1.15	1.11	1.08	1.10
	option 3	1.20	1.12	1.08	1.13
5	option 1	1.06	1.07	1.07	1.07
	option 2	1.12	1.13	1.07	1.11
	option 3	1.17	1.14	1.07	1.15
6	option 1	1.07	1.08	-	1.10
	option 2	1.14	1.14	-	1.14
	option 3	1.19	1.16	-	1.14
10	option 1	1.11	1.12	1.05	1.08
	option 2	1.24	1.26	1.11	1.16
	option 3	1.34	1.30	1.12	1.23

3.2.4 Patterns of Modal Division

Calculations described in the previous section indicate that rail ridership increases are likely to range from some 1,500 to 5,300 persons per day depending on analysis year and type of CMK line improvement. These persons will be drawn from the principal competing modes (cars, buses) or generated (trip made where none was undertaken previously).

European and Japanese rail operation experience suggests that only between 10 and 20 percent of trips drawn to rail as a result of enhanced service can be classified as generated. A factor of 15 percent was adopted for purposes of the current exercise. Therefore, the dominant source for added riders is formed by the road modes. Experience further suggests that public transport systems principally compete with each other for riders that have a choice of mode and are likely to use non-private transport. Diversion of person trips from private mode transport (cars) to public modes has traditionally been much more difficult to achieve. Exceptions exist in those cases where the road system is perceived in increasingly negative terms by the traveling public due to such externalities as extreme congestion, road tolls, limitations on vehicle use, and lack of parking.

Road trips diverted to rail were therefore stratified to car and bus modes assuming that (a) a higher component of bus trips than car trips will divert, and (b) diversion reflects the overall compostion of inter-regional person trips in the corridor (Table 3.2.11). Thus, the absolute number of bus diversions is expected to grow in each analysis year as is the relative share of car diversions.

Table 3.2.11 Mode Split of Diverted Passengers

Year	Mode Split (%) Total Inter-Regional Trips		Diverted Trips by Source (%)	
	Car	Bus	Car	Bus
1989	41	59	26	74
2005	50	50	35	65

The source of total daily person trips diverted to rail can therefore be estimated for each improvement condition (Table 3.2.12).

Table 3.2.12 Source of Additional Rail Riders

Year	CMK Line Improvement	Source of Additional Rail Riders			
		Generated	Diverted		
			Car	Bus	Total
1989	Option 1 = 160 km/h	222	332	925	1,479
	Option 2 = 200 km/h	472	706	1,969	3,147
	Option 3 = 250 km/h	612	917	2,558	4,087
2005	Option 1 = 160 km/h	249	490	909	1,648
	Option 2 = 200 km/h	526	1,043	1,938	3,507
	Option 3 = 250 km/h	683	1,354	2,515	4,552

3.3 Improvement Alternatives

3.3.1 Present Status

1) Status of the Line

Status of the line between Warszawa - Katowice/Krakow is shown in Table 3.3.1. Most sections other than Grodzisk - Psary - Zawiercie were constructed many years ago, and speeds are limited to 120km/h or less because of the many number of curves. A section approximately 20km from Katowice, in particular, has many speed restrictions to prevent accidents which might occur due to the collapse of old coal mines.

Stations' track lay-out of CMK is shown in Fig. 3.3.1. There are 10 intermediate stations, which were for exchanging the freight trains on a single tracked line when CMK was constructed and inaugurated. There is a large locomotive depot and a freight wagon depot at Idzikowice, which are both for freight transport.

Centralized Traffic control (CTC) and Centralized Substation Control (CSC) were installed recently on CMK and the control center for both systems is situated at Idzikowice. Both were developed by CNTK (Technical Institute of PKP) using electronic technology manufactured in Poland. They are on the way of site testing and some of them have been put into actual use.

CMK between Grodisk - Zawiercie is the territory of the East Railway Region situated at Lublin which is located some 150 km east of the line. As for the lines between Warszawa - Grodzisk, Zawiercie - Katowice and Psary - Krakow, they are under the jurisdiction of of Central Railway at Warszawa, the Silesian Railway Region at Katowice and the Southern Railway region at Krakow, respectively.

2) Passenger Transport

Passenger trains operated on CMK are express, fast and long distance night trains, and none of them make intermediate stops between Grodzisk - Zawiercie. The number of trains connecting both terminals within 3 hours was increased to 26 from 16.

The train diagram for 1992 is as shown in Fig. 3.3.2. It should be noted that 5 out of 10 round trips between Warszawa and Katowice were international trains.

3) Freight Transport

Previously many freight trains ran on CMK, approximately 40 in 1980 and 35 in 1985, which were mostly for bulky cargo transportation. However, to increase the speed of passenger trains, freight trains on CMK were transferred to the two parallel lines. The number of remaining freight trains on CMK are as follows.

Between Zawiercie - Psary	northbound	:	15
	southbound	:	17
Between Wloszczowa - Idzikowice	northbound	:	10
	southbound	:	9
Between Idzikowice - Grodzisk	northbound	:	2
	southbound	:	1

It was mentioned by PKP that the remaining freight trains would be transferred to other lines in the coming revision of the timetable.

Table 3.3.1 Status of CMK line

Section	Route Length	Allowable speeds	Radius of curves	Speed restriction	Gradient & Others
Warszawa Central - Grodzisk	29.5 km	60 km/h 120 km/h	400 m	100 km/h	0.87 %
Grodzisk - Psary - Zawierwicie	224 km (1)	160 km/h	4,000 m 610 m (2)	100 km/h	0.6 % CMK
Zawiercie - Katowice	44 km	120 km/h 70 km/h	300 m	60 km/h 30 km/h	0.71 %, Coal mine damages
Psary - Krakow	93.3 km	120 km/h 100 km/h	300 m	60 km/h 30 km/h	1.20 %

Note (1) Route length between Grodzisk - Psary is 170.5 km.
(2) There is a curve with 610 m radius at Zawiercie.
There are a few curves with 2,000 m radius near Grodzisk and Zawiercie.

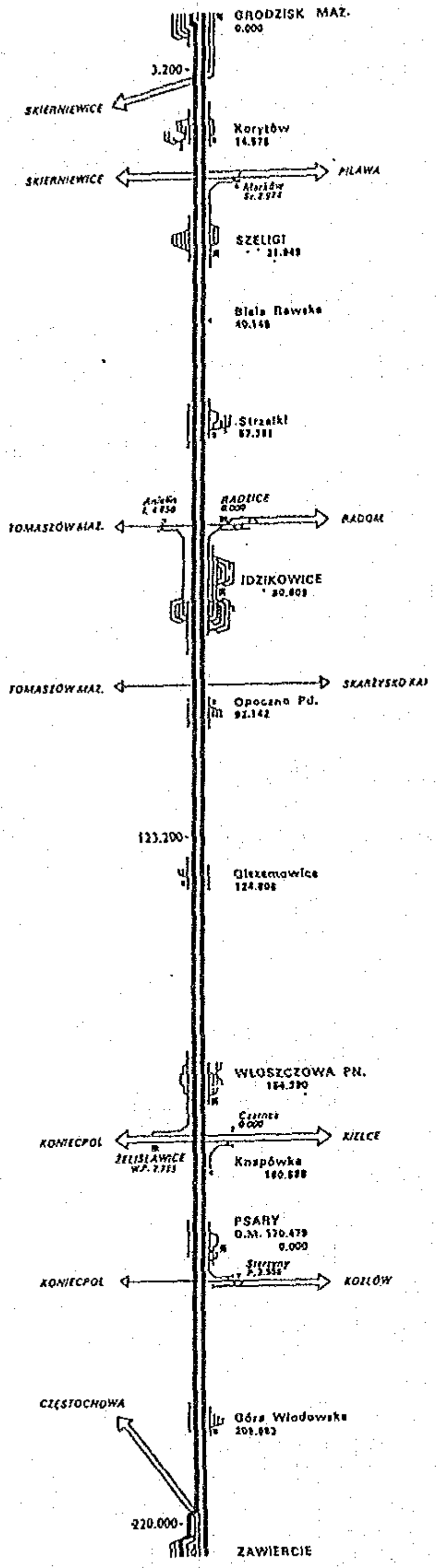


Fig. 3.3.1 Track Layout of CMK

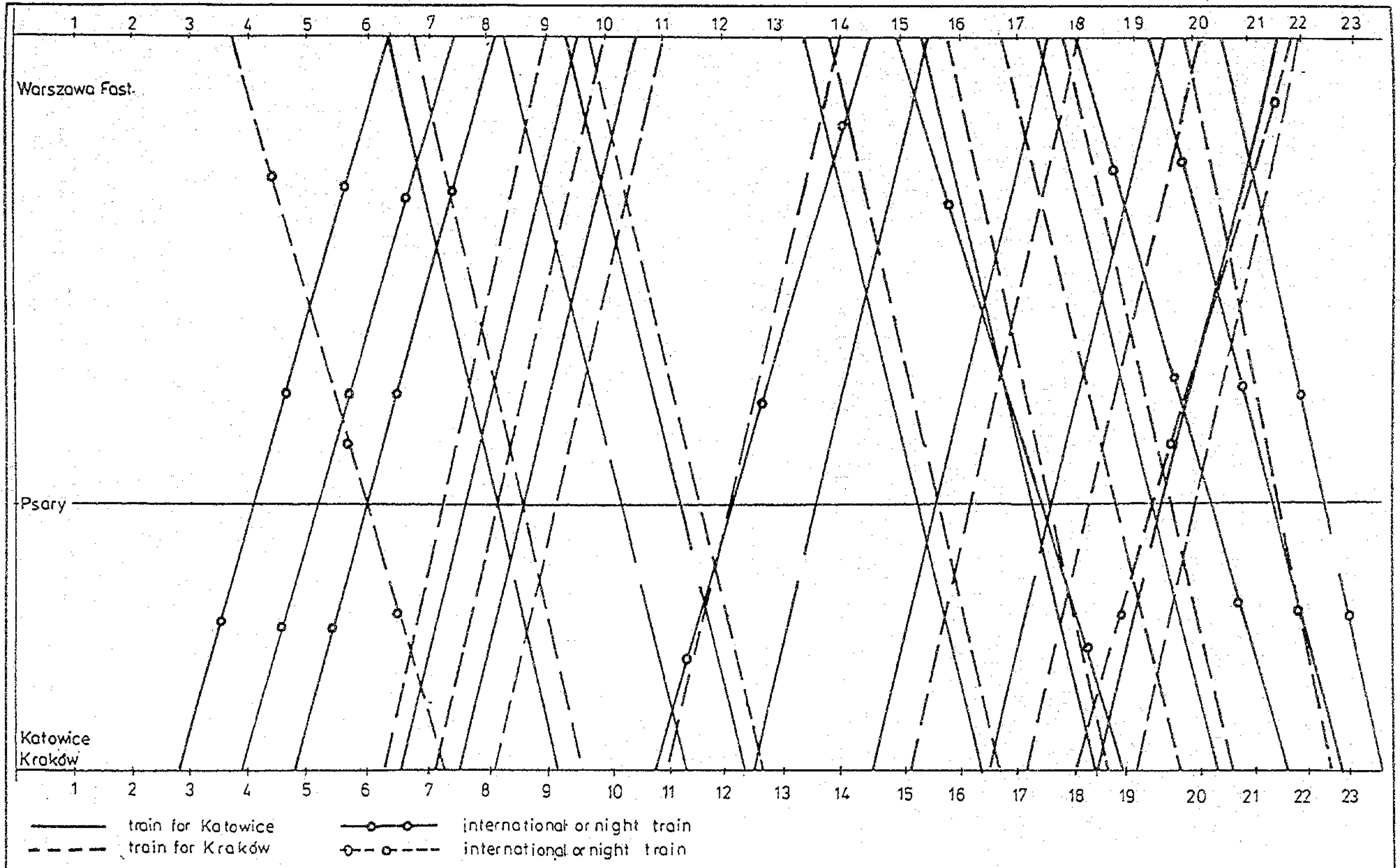


Fig. 3.3.2 Train Diagram on CMK (Passenger Trains)
as of May 31, 1992

3.3.2 Operation Plan and Rolling Stock

1) Characteristics of Proposed Trains

Composition of the trains for each alternatives are as mentioned in 3.1.3. 2). Characteristics of the proposed trains in terms of tractive effort and running resistance are as shown in Fig. 3.3.3. The resistance was calculated based on Davis formula coupled with experimentation of Japanese Shinkansen.

2) Traveling Time

The present allowable speeds on each section of the lines and the allowable speeds after the improvement are shown in Fig. 3.3.4 and Fig. 3.3.5. Based on the profile of the lines, the allowable speeds and the characteristics of the trains, train running simulations were carried out. The traveling times are summarized in Table 3.2.2, where a spare time of 11 minute is included in the total traveling times for the 200 km/h case and 250 km/h case. The spare time was estimated to enable single track operation at a section undergoing track maintenance.

Compared to the present situation, the improved 160 km/h case (which depend on the improvement of allowable speed using the same rolling stock) will bring about a 10-minute improvement in traveling time, and the 200 km/h case and 250 km/h case will bring about around 30-minute and 40-minute improvements respectively.

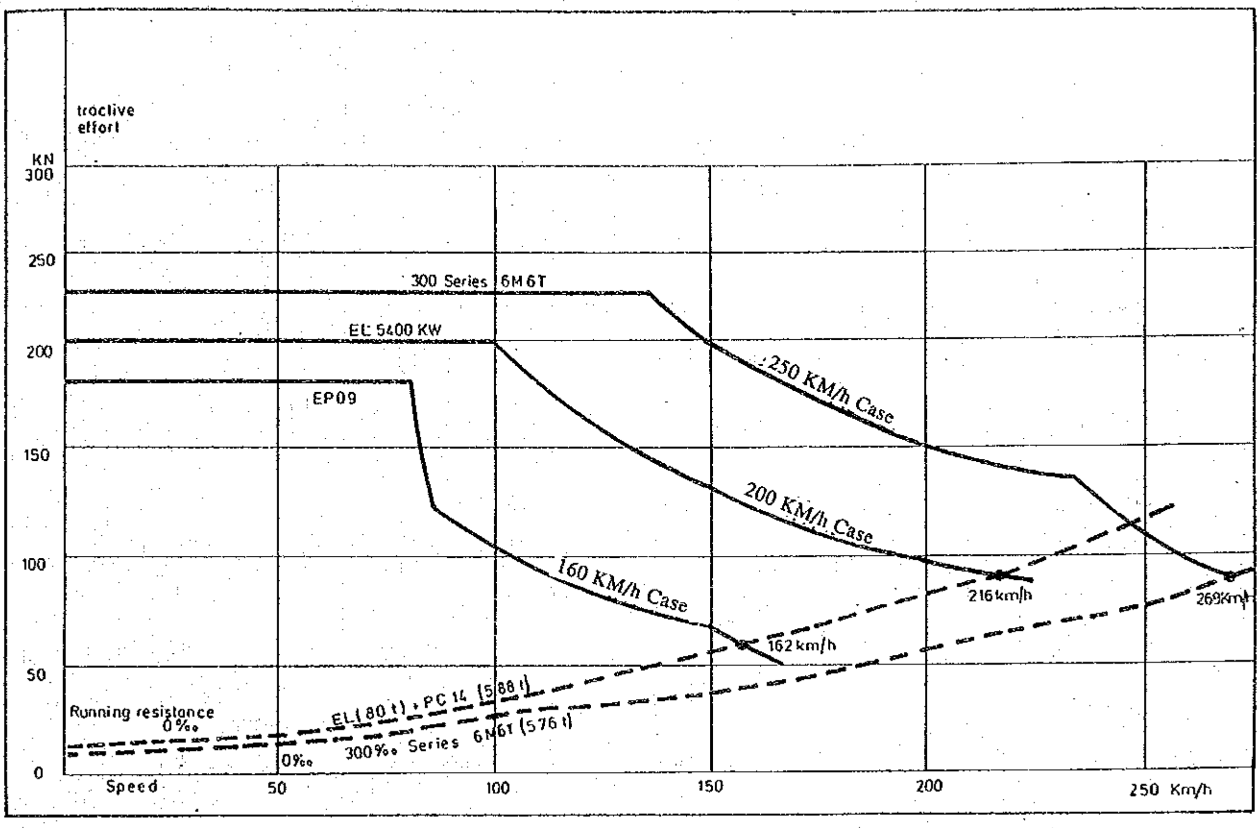


Fig. 3.3.3 Comparison of Characteristics of Proposed Trains

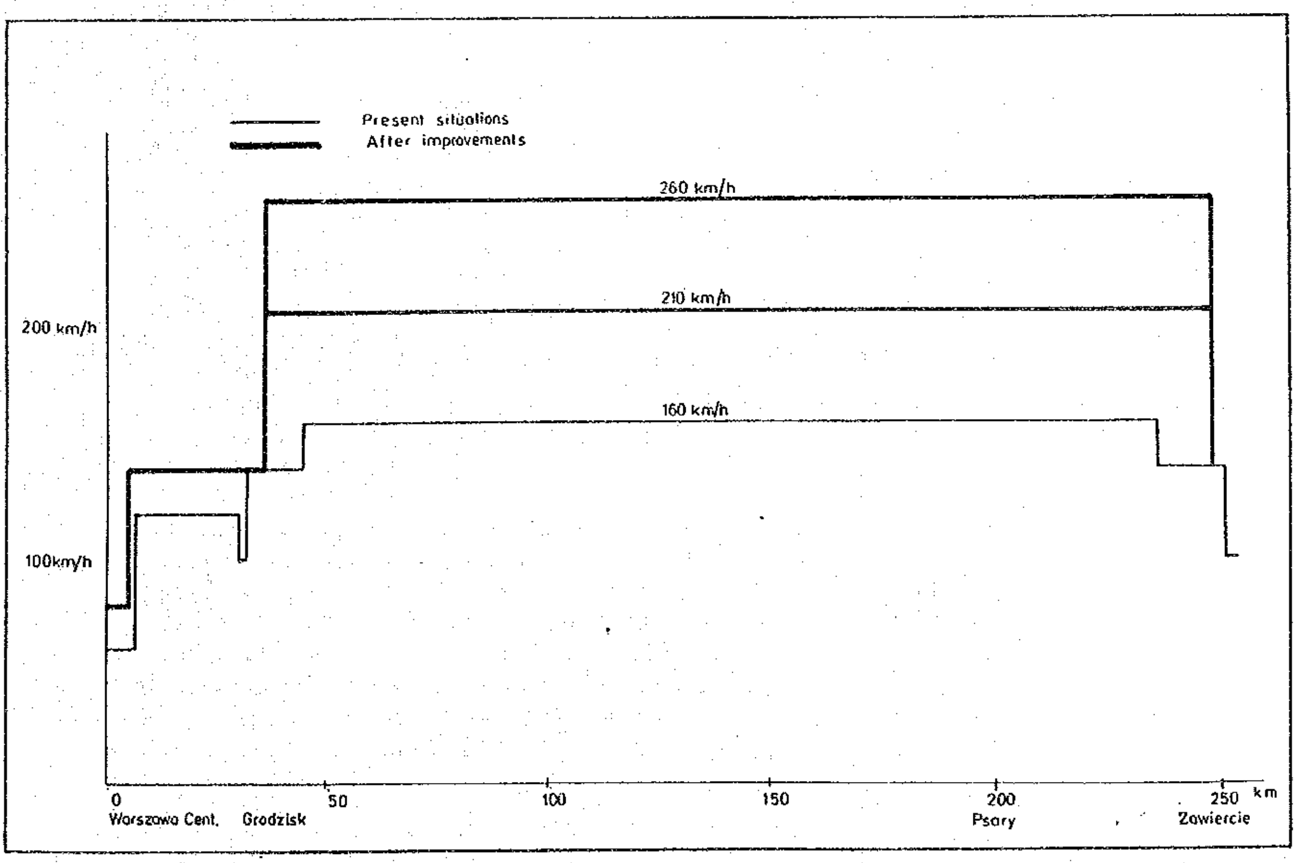


Fig. 3.3.4 Allowable speeds on CMK between Warszawa Centralna and Zawiercie

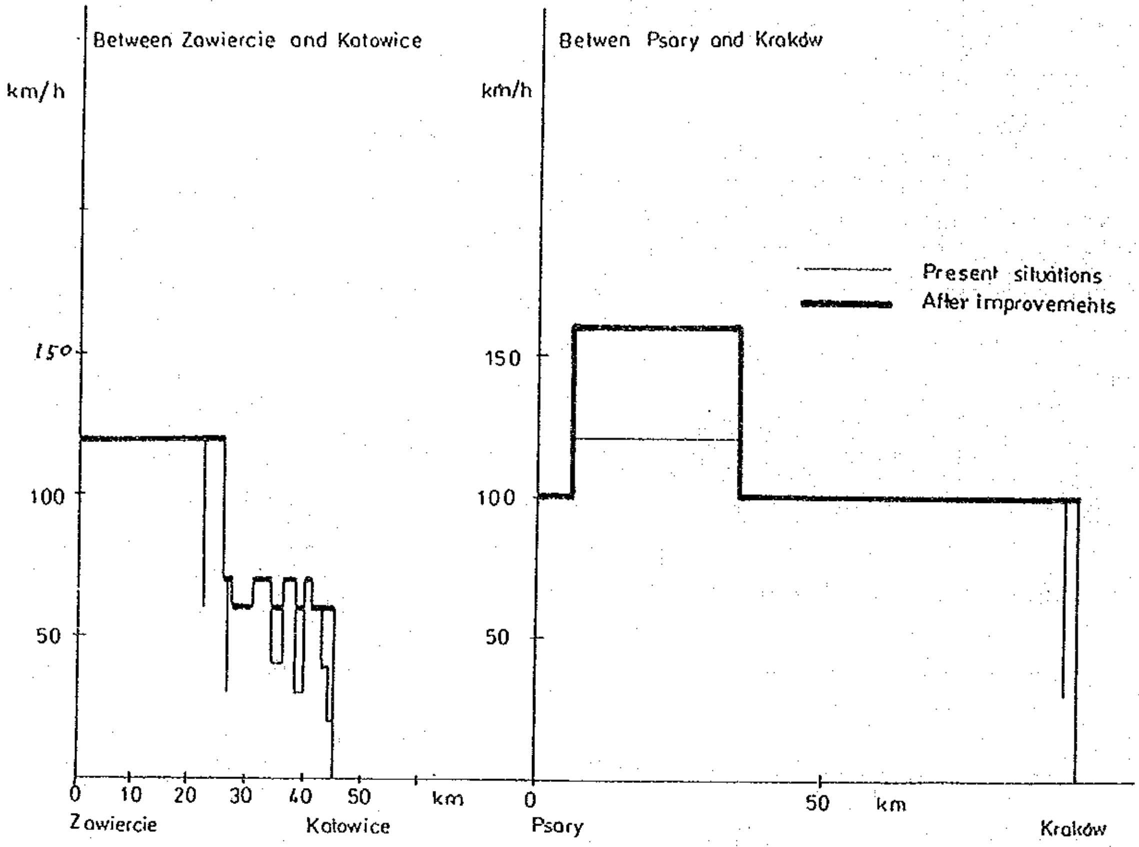


Fig. 3.3.5 Allowable Speed between Zawiercie - Katowice and Psary - Krakow

Table 3.3.2 Traveling Time on CMK Line

Options	No. Improvement		Improved 160 km/h case		200 km/h case		250 km/h case	
Train Composition	EP09+14 cars		EP09+14cars		EL5,400kw+14car		300series 6M6T	
War. Cen. - Katowice	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
War. Cen. - Zawiercie	114	39	109	27	87	6	73	36
Zawiercie - Katowice	40	8	35	38	35	38	35	38
Spare Time	9	43	9	55	12	16	11	46
Total	165		155		135		121	
Katowice - War. Cen.	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
Katowice - Zawierce	40	34	35	15	35	15	35	15
Zawiercie - War. Cen	113	15	107	53	86	32	73	30
Spare Time	11	11	11	52	12	13	12	15
Total	165		155		135		121	
War. Cen. - Krakow	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
War. Cen. - Psary	91	14	86	31	69	26	58	49
Psary - Krakow	56	0	51	35	51	35	51	35
Spare Time	12	46	11	54	10	59	11	36
Total	160		150		132		122	
Krakow - War. Cen.	Min.	Sec.	Min.	Sec.	Min.	Sec.	Min.	Sec.
Krakow - Psary	56	57	52	24	52	38	52	38
Psary - War. Cen.	89	56	84	21	67	53	57	51
Spare Time	8	7	13	15	11	29	11	31
Total	155		150		132		122	

(Note)
Intermediate Stations
Warszawa Central - Katowice Zawiercie: 1 min. Sosnowisc: 1 min.
Warszawa Central - Krakow Non stop

3) Train Diagram

A typical train diagram between Warszawa East and Katowice/Krakow for the 200/km case are shown in Fig. 3.3.6. Traveling times between Warszawa East - Katowice and between Warszawa East - Krakow were set at 145 minutes and 142 minutes respectively. From 6 o'clock in the morning until 20 o'clock, trains start every hour both ways between Warszawa - Katowice and Warszawa - Krakow, except from 10:00 to 14:00 hours when demand is slack. For the convenience of passengers, changing trains from or to other lines at Warszawa stations, time interval between a train bound for Katowice and a train bound for Krakow is preferably within 15 minutes. This principle was followed by the train diagram except from 09:00 to 14:00 hours, when it is set at 30 minutes to enable single track operation for maintenance reasons.

The total number of trains in the train diagram is 52. The maximum number of the passenger coaches is 14 including one dinning car, and the average number of seats per passenger coach is 67. This results in the daily total number of seats being 52x13x67=45,292, which is 1.9 times more than the traffic demand of the 200 km/h case in 2015 shown in Table 3.2.5. Therefore, the timetable can meet the traffic demand of 2015 with enough margin. The traffic demand in 1998, which is 77 % of 2015, can be met reasonably by the same train diagram by adjusting the number of passenger coaches per train.

The train diagrams for the improved 160 km/h case and 250 km/h case were assumed to be the same as the 200 km/h case except for the traveling time.

4) Number of Rolling Stock

It is essential to increase the availability of rolling stock for high speed operation. The time between train arrival and departure at terminal stations should be shortened by all means.

At Warszawa East most of the arriving trains could be prepared to depart from the platforms by a slight modification of the track layout and by preparing of water supply facilities. At Katowice, staying tracks can be prepared at the former freight station situated south of the platforms and arrival trains can be prepared to depart from there. Krakow station is being improved overall, and the staying tracks for passenger coaches are to be moved south of the platforms, which will enable arriving trains to depart in a short time. If gangs were to clean up passenger coaches at platforms or at staying tracks adjacent to the platform of each station, the time between the arrival and the departure can be shortened to within 30 minutes, including the movement of the locomotive itself.

Then necessary number of train sets (Table 3.3.3) for the train diagram were obtained as follows.

	Necessary train sets
Warszawa East - Katowice	6
Warszawa East - Krakow	6
Spare Sets	3
Total	15

Some of these train sets will be idle between 13:00 to 16:00 hours and between 20:00 hours to 06:00 hours the next day at the terminal stations, then some of them can go further down to other lines. In the 250 km/h case, where traveling times can be cut by around 10 minutes, the same number of train sets are needed. On the other hand, in the improved 160 km/h case, traveling times increase by 20 minutes compared to the 200 km/h case, the necessary number of train sets increases to 19, including 3 spare sets.

In the case where no improvements are made, time interval between arrival and departure of trains was assumed to be 3 hours the same as present. The number of total trains between Warszawa - Katowice/Krakow was assumed to be 40 for 1998. Total number of necessary train sets will be 24 including 4 spare sets.

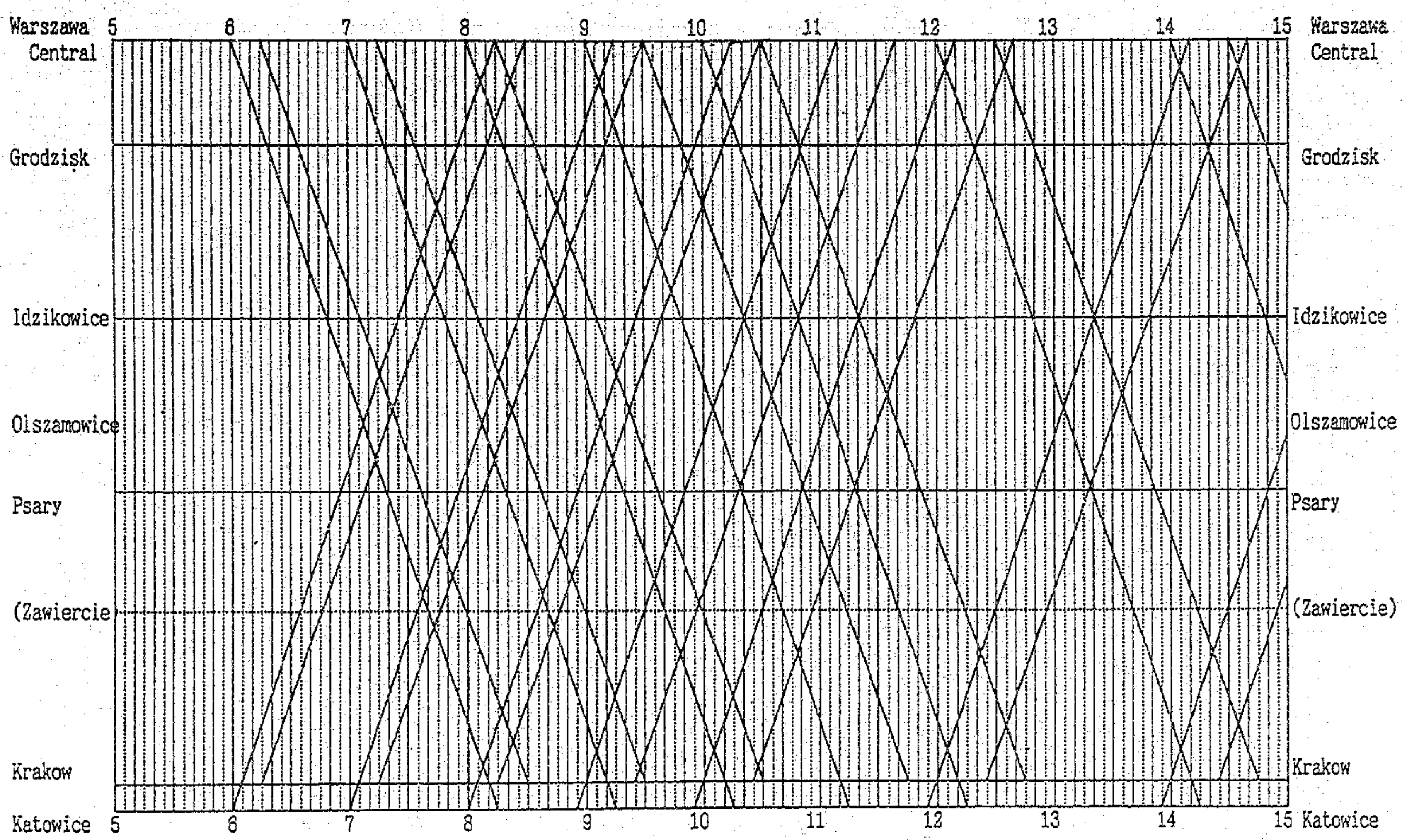


Fig 3.3.6 CMK Train Diagram (Options 200 km/h)

CMK Train Diagram (Alternative 200km/h)

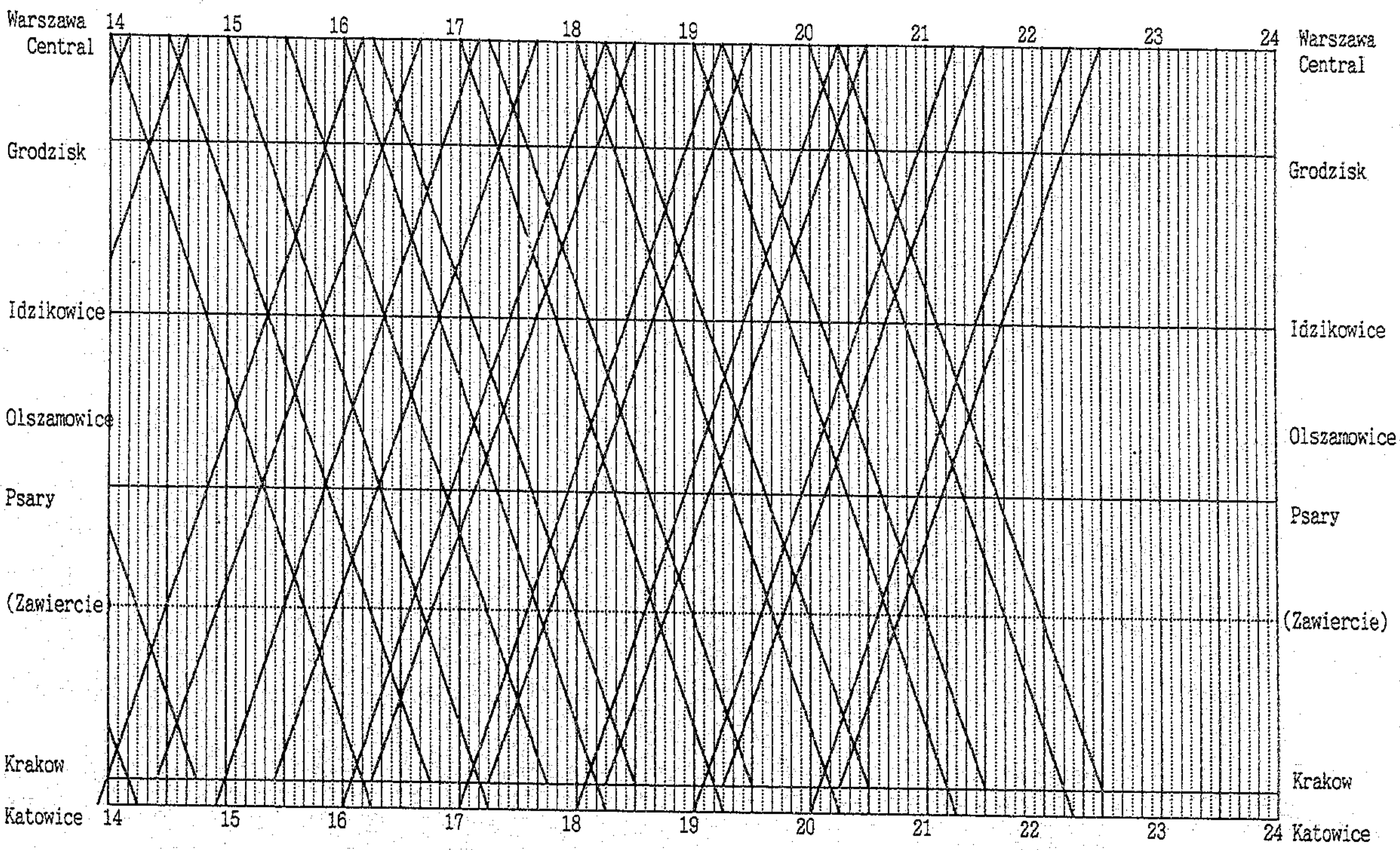


Fig. 3.3.6 CMK Train Diagram (Options 200 km/h): Continued

Table 3.3.3 Number of Necessary Rolling Stock

Options Train Composition	No. improve EP09+PC	160 km/h EP09+PC	200 km/h 5,400kw+PC	250 km/h 300 series
Year	1998	1998	1998	1998
Number of Passenger/day	14,913	16,392	18,060	19,000
Number of Trains/day	40	52	52	52
Number of Coahes Per Train	9	8	8	10
Needed Train Sets	24	19	15	15
Number of Locomotives	24	19	15	
Number of Coaches	216	152	120	150
Year	2005	2005	2005	2005
Number of Passenger/day	16,614	18,262	20,121	21,166
Number of Trains/day	40	52	52	52
Number of Coahes Per Train	10	8	9	10
Needed Train Sets	24	19	15	15
Number of Locomotives	24	19	15	
Number of Coaches	240	152	135	150
Year	2015	2015	2015	2015
Number of Passenger/day	19,280	21,195	23,350	24,563
Number of Trains/day	40	52	52	52
Number of Coahes Per Train	11	10	11	12
Needed Train Sets	24	19	15	15
Number of Locomotives	24	19	15	
Number of Coaches	264	190	165	180

(Note) Number of coaches per train is estimated as follows.
Average number of seats per coach: 67
Average occupancy of seats: 0.7
One dining car per train .

3.3.3 Track and Track Structure

1) Track on CMK Line

The CMK was constructed in the 1970s to transport increasing freight between Central Poland and the Katowice/Krakow Region. The Main track consists of UIC 60kg/m continuous welded rail, wooden sleepers (1773 pieces/km) and K rail fastners. The CMK has many siding track and turnouts for freight train operation.

Main track length	448.0 km
Siding track length	433.6 km
Turnout	495 Sets

Most of the siding tracks and turnouts will be demolished in the case of options of improved 160km/h, 200km/h and 250km/h.

2) Track Maintenance Organization

The entire CMK track is maintained by the Lublin DOKP (Regional Railway Division) and the Radom DO (Track Maintenance office) with 4 DS (track maintenance branch office). The territory of each DS is as follows:

Korytow	DS	3.2 km - -63.3 km	(60.1 km)
Opoczno	DS	63.3 km - 123.2 km	(59.9 km)
Wloszozowa	DS	132.2 km - 171.8 km	(48.6 km)
Wlodowska	DS	181.8 km - 220.0 km	(48.2 km)

The number of employees for 4 DSs is 531 persons with 13 % of them on the managing staff. One heavy track maintenance machine group is dispatched from DOM (mechanized track maintenance office) for the CMK track maintenance using machines including a Plasser-09 multiple tie tamper, a Plasser-275 switch multiple tie tamper, and DGS stabilizer, etc.

The amount of track maintenance works are reduced according to reduced passing tonnage, reduced number of heavy axle loads, reduction of siding tracks and turnouts in the case of options with 160km/h, 200km/h and 250km/h. Tracks in good repair are destroyed mainly by heavy axle loads and freight wagons that have low level running characteristics. When a modernized track maintenance method using computers such as utilized on the Japanese Shinkansen is applied to the CMK track maintenances in the case of options 200km/h and 250km/h, track maintenance works will be reduced further. Once the track is repaired in good condition for high speed operation, the vibration of the train is reduced, the destruction of track by trains is also reduced as a result.

3) New Organization for High Speed Train Operation

New and modernized track maintenance system and methods are considered necessary for alternatives 200km/h and 250km/h because track maintenance technology for high speed operation differs from that used for 160 km/h technology.

Accordingly, a CMK DO should solely be established separate from Radom DO. This CMK DO would be responsible solely for CMK track. The scope of work of the CMK DO would be the management of the CMK track and subsidiary works for the head office because the CMK DO would be the only office to have technology for high speed operations.

The CMK DO would have a central track maintenance commander in the CTC office that would manage track maintenance works related to train operations, e.g. window times (time between trains) and speed restrictions.

As track maintenance works would be executed mainly by heavy track machines, DO would require 2 mechanized track maintenance gangs (working party, hereinafter DSM) separate from the DOM.

New CMK DO Organization

- CMK DO
  - Central Commander (in the CTC)
    - Regional commander (Opoczno)
    - Regional commander (Wloszczowa)
  - DS Korytow
  - DS Opoczno
  - DS Wloszczowa
  - DS Wlodowska
  - DSM

4) Track Maintenance Works

Track irregularities have been measured 4 times yearly by Plasser EM-120 and track maintenance works are executed according to the chart recorded by EM-120. All track maintenance works are executed in the daytime with the window time secured by single track operation.

A working group from DOM executes track maintenance works using heavy track machines and DSs execute inspection of track, replacement of track material and the support of DOM works.

Track measurement should be undertaken every 10 days in the case of alternatives 200 km/h and 250 km/h because track irregularity repair works should be done using the latest data. This increases efficiency. PKP has covered all tracks in PKP by 2 EM-120, but PKP needs to buy one more EM-120 to cover the CMK measurement in the case of options 200km/h and 250km/h.

5) Track Renewal Plan

The CMK track construction works were implemented from 1974 using S49 rail as a temporary rail. The S49 rail was replaced with 60 kg/m rail from 1977 and the entire rail replacement was finished in 1984. The passing tonnage of No.2 track (track to Warszawa) from 1977 was estimated at 440 million tons in 1991. Rail is replaced in accordance with the fatigue limitation in the PKP of 450 million tons.

Therefore, PKP has began to replace rail from 1991 and the remainder needs to be replaced by 1997. Sleepers were equipped on the CMK line from 1973 and the number of sleepers to be replaced is increasing now. Track is renewed with UIC 60 continuous welded rail, concrete sleepers and elastic fastening instead of K fastening. Ballast is cleaned during the whole track material replacement work. Track replacement works are implemented by a DOM track replacement group that has capacity of 80 km per year.

PKP has planned the replacement of track material taking into consideration future high speed train operation. It is a reasonable plan, even if high speed trains are not operated, because the purchasing of hardwood sleepers becomes more difficult year by year due to the lack of wood resources and the moves to preserve forest products. Moreover, the price of wooden sleepers with K fastening is similar to that of concrete sleepers with elastic fastening. It is clear that the track structure with concrete sleepers with elastic fastening saves track maintenance costs and PKP also applies the same criteria to other main lines.

Consequently, the track structure of the CMK is to be same for all 4 alternatives with the difference between 4 alternatives to be in maintenance system and technology. The life of tracks in the case of options of 160 km/h, 200 km/h and 250 km/h will extend to over 30 years due to the reduction of passing tonnage.

6) Location of Stations and Turnouts for High Speed Trains

It is essential for high speed train operation to eliminate gaps in crossing rail, so it is essential to use a turnout with a movable nose crossing. These turnouts will be imported because the casting of these crossings requires high technology and the manufacturing lots are too small for domestic production. It is necessary to reduce the number of the movable nose turnouts as much as possible, because the price of the turnout is very high. Current turnouts are to be used for alternatives "without" and "with" 160 km/h. The following considerations are to be taken into account in the planning of station locations and layouts that have movable nose crossings;

a. Arrangement of stations is necessary at intervals of approximately 60 km for passing trains or reception of broken trains when train components are not in order.

b. Interlocking stations are necessary at intervals of approximately 40 km for single track operation for maintenance works during the daytime.

c. Interlocking stations are necessary for train passing and single track operation at night.

Taking in consideration the above mentioned matters, track layout of each option is assumed (Fig. 3.3.7).

7) Level Crossings

The target for the CMK line is to have no level crossings because the CMK Line was planned to be constructed with the same high grade criteria as the Tokaido Shinkansen in the 1970s. The CMK already has 49 grade separated crossings (one is under construction) and 20 level crossings at present. The traffic volume of these 20 level crossings is small but 11 level crossings out of the 20 are guarded. PKP has constructed 2 or 3 flyovers every year and has plans to eliminate all level crossings by 1997. Elimination of level crossings for 4 alternatives is the same in plan and cost.

8) Station Facilities

(1) Existing Stations

The 9 stations of the CMK between Grodzisk and Zawiercie were constructed for freight train operation. Thus, there are no passenger stations except for the stations of Grodzisk and Zawiercie, at either end. If CMK wants to have passenger stations, it is Opoczno city that has a population of 20 thousand. Every station has a sufficient number of siding tracks and turnouts and with the effective length of approximately 1,000m. When freight trains are deleted from the CMK, these sidings and turnouts should be demolished to reduce maintenance costs.

(2) Track Layout in Stations

There are 500km of track 495 turnouts in stations mainly for freight trains. Most of this track will be demolished in the case of adoption of options with 160km/h, 200km/h or 250km/h, due to the elimination of bulk freight trains from the CMK. Detailed track layout in stations will be determined in accordance with the kinds of trains used for each alternative.

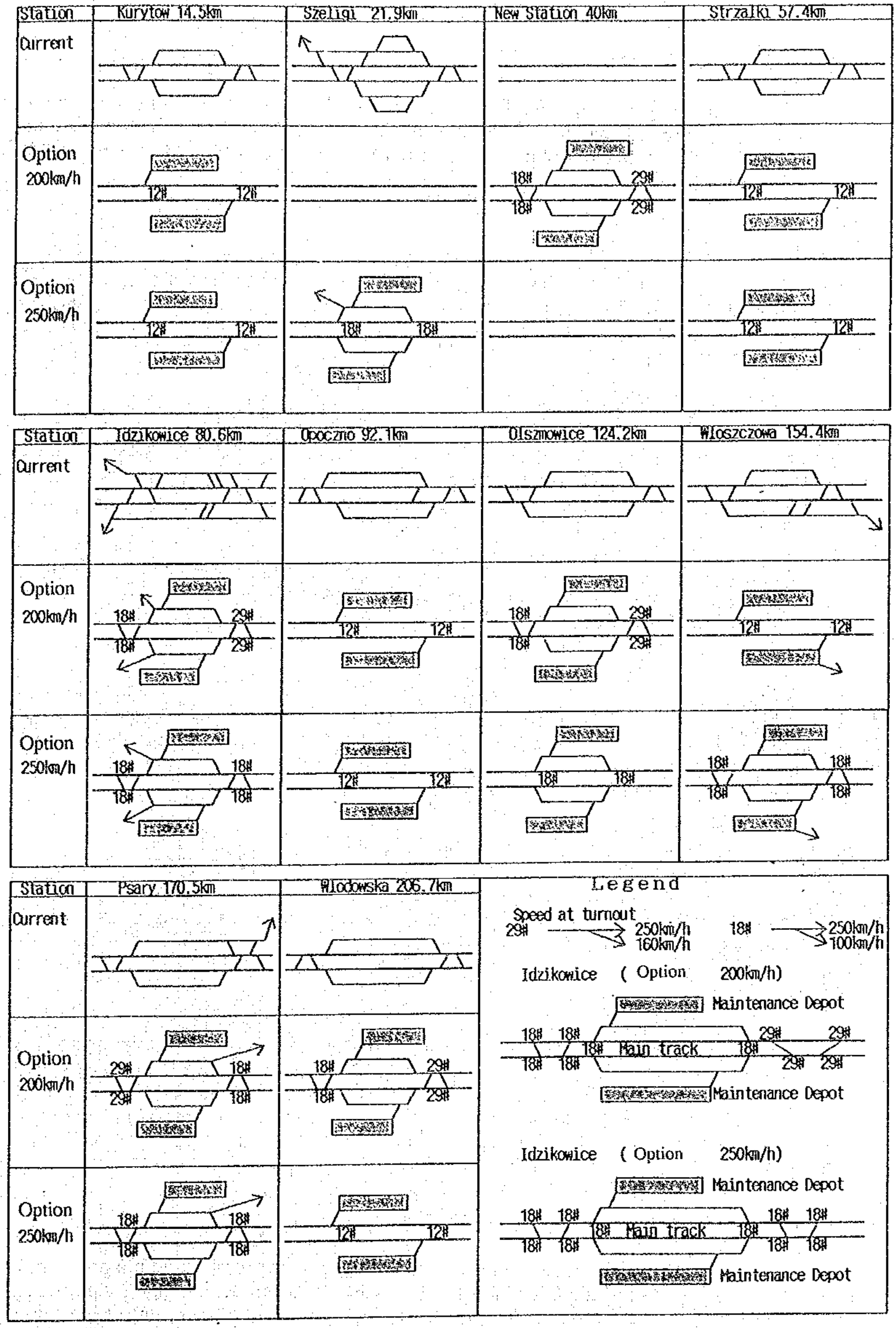


Fig. 3.3.7 Station Layout of Options 200 km/h and 250 km/h

(3) Tracks at Terminal Stations.

Tracks for engine run-round, repair, car washing, night staying and water supplying are necessary at terminal stations, e.g. Warszawa, Katowice and Krakow. Some of them will use existing track but some modifications are taken into consideration.

(4) Drainage of Wastewater

The toilets of passenger cars will use circulated flushing water for environmental protection. Toilet wastewater will be drained at terminal stations once every day or every two days into city sewer pipes. Treatment facilities for wastewater is not included in the project.

9) Maintenance Depots

Track and electric facility maintenance depots are presently equipped at 9 station. The 4 options would all use the current maintenance depots because it is necessary to save travel time to the working site in order to use the window time efficiently. (Fig. 3.3.8)

The depots not belonging to a station has turnouts to connect to the main line. As depots have no crossover turnouts on main lines in the case of alternatives 200 km/h and 250 km/h, an underpass tunnel with track will be constructed in order to move maintenance machines from the No. 1 track side to the No. 2 track side and vice versa.

10) Bridges

The number of bridges with spans of over 30m are 6. These bridges pass over the roadway. The designed deflection of a bridge is 1/700 x length of span. The vertical alignment including deflection in long span bridges will be measured by test running and will be adjusted for smooth running.

11) Maintenance Road

Roads to approach the CMK track are necessary for maintenance works. Accordingly PKP has constructed maintenance roads from the 1970s and this plan will be implemented for any of the 4 alternatives.

12) Fences

Fencing is essential to prevent humans and animals from entering the territory of the railway track in the case of options 200km/h and 250km/h. For these options, sound protection walls and flying ballast protection walls will be necessary for the houses near the track. Highway overpass bridges require fences to prevent flying ballast damage. The CMK route runs in the area of forests, farms and sparse housing, so the total lenth of fences to be equipped will not be extermely long.

13) Control of Speed Restrictions

Control of time loss due to speed restrictions is necessary to achieve punctual train operation scheduling in the CMK. Long term speed restrictions should be eliminated by investment in improvement. The Following temporary time loss control measures are included in the train operation planning:

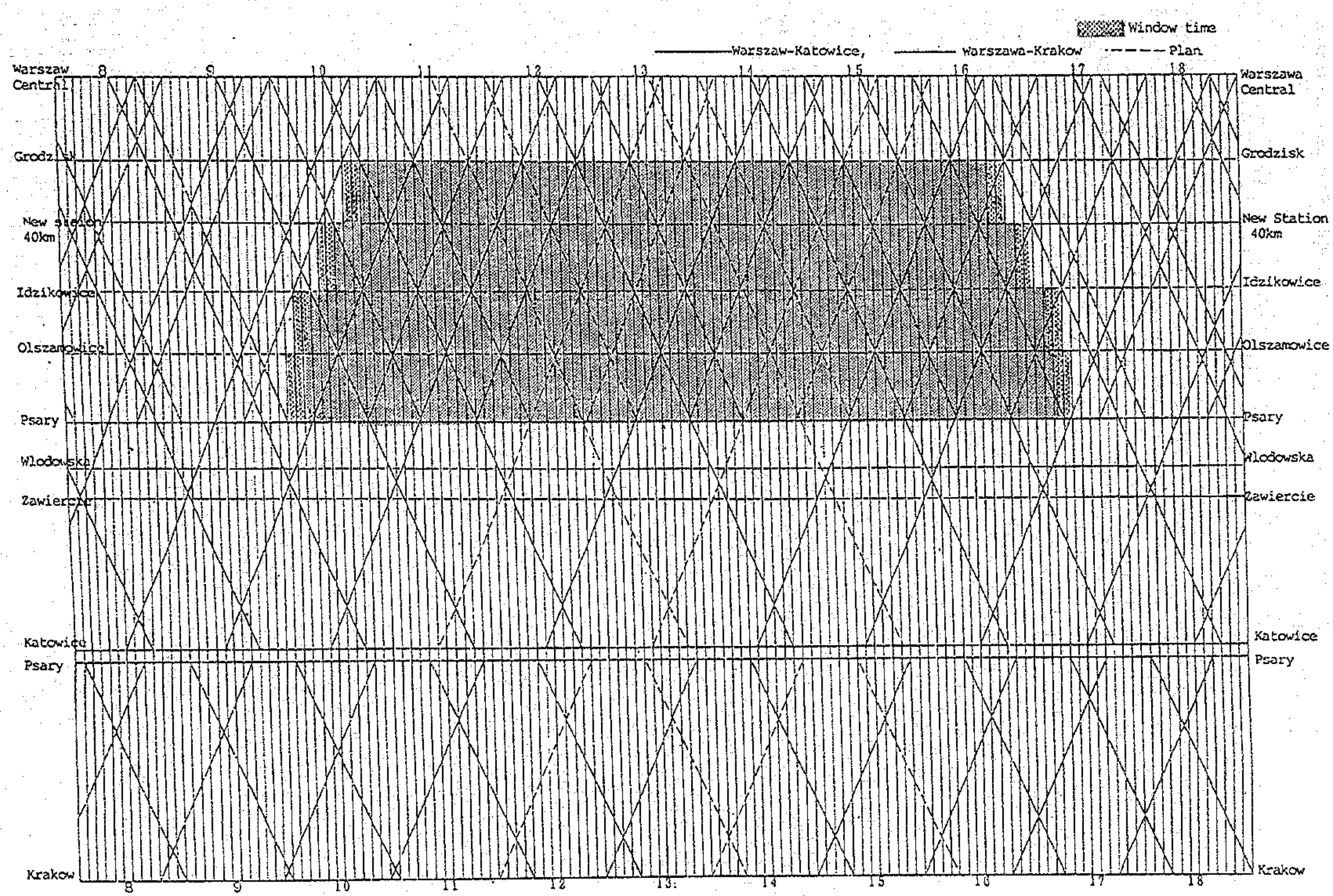


Fig. 3.3.8 Window Time for Maintenance Works by Single Track Operation and Station Plan

- Time loss by single track operation and maintenance works

  Maintenance works will be executed in the daytime at one section on the No. 1 track and the No. 2 track respectively. This time loss by speed reductions is to be kept down to 7 minutes.

- Time loss for improvement works

  Speed restrictions due to improvement works, e.g. ballast replacement or bridge repair, should be limited to 2 places on each track, with an estimated speed of 120km/h and a time loss of 3 minutes. Annual improvement works should be planned to limit speed restrictions in 2 Places at the same time and working methods and terms should be studied, e.g. the speed restriction after ballast replacement is 180 km/h for 2 days in Japan but 60km/h for 2 weeks in PKP.

- Temporary speed reductions

  Large car vibration will probably be reported from drivers frequently at speeds over 200km/h. Approximately 60% of the vibration originates from the rapid growth of track irregularity. When the report from a driver is received, train speeds will be reduced to 160km/h or less, with time loss of 1 minute.

A total of 11 minutes of time loss by temporary speed down every day is included in the train operation planning as spare time allotted. The ratio of on-time operation for the Tokaido Shinkansen is 98% (within 5 minutes delay) with the remaining 2% due to unexpected rolling stock failure of disturbance by outsiders.

14) Environmental Preservation

(1) Noise

There are no regulations for railway noise in Poland now, but these will be introduced in the near future. Therefore, it is necessary to study the reduction of noise generation and to provide noise protection countermeasures.

Germany regulates railway noise as follows, providing a good reference for the CMK:

	daytime	night
For hospitals and schools	57	47
For residential areas	59	49
For cities and rural areas	64	54
For commercial and industrial areas	69	59

(unit:Leg dB(A), Equivalent noise energy level)

The reduction of noise generation from rail and wheels is difficult but it is possible to reduce noise from outside track by equipping noise protection walls. The second highest level of noise is aerodynamic noise from the pantograph and car body. Therefore, the design of the lead car (heading car), smoothing of the surface of the car and aerodynamic improvement of the pantograph should be studied in the course of the rolling stock design. In addition, constriction of noise protection walls, double glazed windows and relocation of houses are available countermeasures for residents. there are few houses along the CMK track but

PKP needs to continue observation of construction of houses along railway track and when there are plans to construct houses, it is better to negotiate with the people to locate houses over 50 m from the track in the case of residential housing and over 100m in the case of hospitals and schools.

(2) Drainage of Car Toilet Wastewater

The toilets of passenger cars should use a circulated flushing water system for environmental protection and the consideration of ground workers. PKP already has equipped the system in some of the international passenger cars.

(3) Flying Ballast

Ice block drops from the car body and creates flying ballasts at high speed. Thus, flying ballast may cause considerable damage in the winter. Flying ballast strikes walls and rebounds and crashes car window glasses, and breaks car under floor equipment and breaks the roofs of houses in the winter on the Tokaido Shinkansen. It is necessary to equip protection netting for houses and roads. Guards for under floor components should be considered.

15) Related Sections

(1) Warszawa Central - Grodzisk (30 km)

The 7km of track from Warszawa Central to Warszawa West has a large number of turnouts and branch tracks that restrict train speeds to 60km/h.

The track between Warszawa West and Grodzisk has a number of curves with radius of approximately 2,000m and 1 level crossing that is undergoing flyover construction. Rail was replaced in 1975 and the ballast is soiled.

The speeds along this section are 120km/h in the case of alternatives "without" and that 140km/h in the case of "with" 160km/h, 200km/h and 250km/h respectively because of the improved track maintenance and the efficient rolling stock. There is a good probability that trains will be able to run at a speed of 200km/h as the permanent way criteria are good, but this will be planned in the next stage improvement project.

The following improvements should be considered for a speed of 200km/h:

- Fencing and noise protection walls are necessary
- There are no level crossings except one undergoing flyover construction, but there are a number of unofficial level crossings. Thus, it will be necessary to construct flyovers for passers-by.
- There are yards, siding tracks and turnouts that should be simplified.

(2) Zawiercid - Katowice (44 km)

This section has a dense railway network, so there are many turnouts to branch and crossover tracks. Passing tonnage is so large that that the condition of the track is not good. There are speed restrictions of 60km/h and 30km/h because of coal mining subsidence. There are 2 kinds of mining subsidence:

- Railway track subsidence due to coal mining that can be calculated estimated at approximately 25cm per 2 years. This subsidence needs frequent track maintenance work in order to maintain track regulations.

- There were examples of sudden depression of the ground near the railway track in the 1970s, so speed restrictions of 30km/h are implemented at present to prevent related train accident. It is possible to raise the speed by equipping an alarm system to detect sinking track because rapid and large amount of sinking are easy to detect. Example of the collapse of embankment were not seen in the railway territory in the 1970s and these were none in the 1980s.

PKP needs to study such an alarm system to raise the speeds along this section. For, if there are no speed restrictions, approximately 360 minutes of passenger train hours/day at the entrance of Katowice station will be saved.

(3) Psary - Kozlow (35 km)

This section was constructed in 1975. The radius of the curves are approximately 1,200m. Passing tonnage is small and the track condition is good. The screening of the ballast on the No. 2 track was completed recently. These are 15 level crossings. 3 level crossings have approximate road traffic of 200 cars/day and another has approximately 50 cars/day. The maximum speed can be raised to 160km/h in the case of options with 160km/h, 200km/h and 250km/h with the construction of 3 grade-separated crossings and alarm equipment for the other level crossings.

(4) Kozlow - Krakow (58 km)

This track section runs through hilly areas and has many small radius curves. There is no improvement plan for this section.

3.3.4 Electric Traction Equipment

1) Overhead Contact Wire Equipment

(1) Present Status

Overhead contact wire equipment for CMK is as shown in Fig. 3.3.9. This could meet high-speed operation of up to 250km/h in terms of proper contact with pantographs, if the heights and tensions of the wires are adequately adjusted, which should be tested before the inauguration of high-speed operation. The equivalent resistance of electric traction circuit per kilometer of single track is estimated as 0.0615ohm, when 10% of the contact wire is worn.

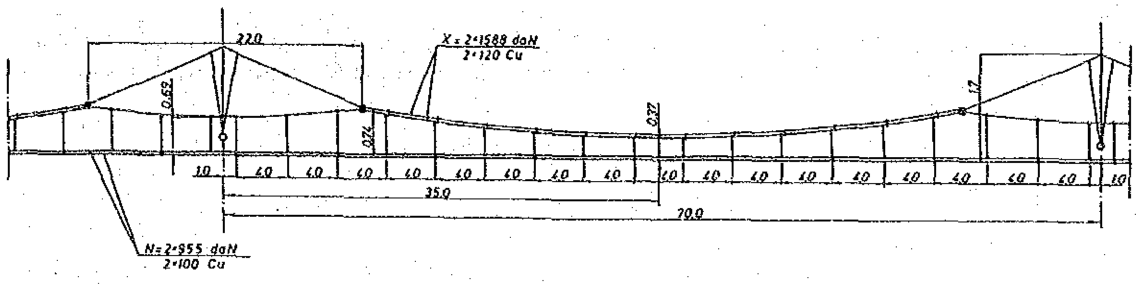


Fig. 3.3.9 3KV Overhead Contact Wire Equipment on CMK

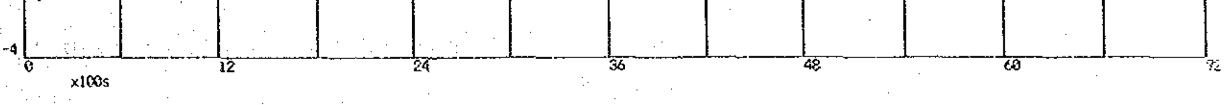


Fig. 3.3.10 Overhead Wire Current for a Train (200 km/h Case) from Warszawa Central to Zawiercie

(2) Necessary Improvements

The results of the simulation of overhead equipment current for the train in the 200km/h case shown in Fig. 3.3.10. The maximum current in the 200km/h case, 2,300 A can be met by the present equipment, where the sectional area of the copper wires is 120mm square x 2 + 100 mm square x 2 and the current is shared by both substations.

However, the maximum current in 250km/h case, 3,500 A cannot be met by the present equipment. The contact wires should be replaced with 150mm square wires.

2) Traction Substation

(1) Present Status

Between Grodzisk and Zawiercie, where the high-speed operation is planned, there are 13 traction substations with an average spacing of 18km. Each substation has 3 sets of 2,500kw silicon rectifiers (one is for standby), with an overload capacity of 150% for 2 hour periods and 300% for 5 minute periods. A 110kv transmission line with 2 circuits was constructed along CMK line, and a substation with 110kv/15kv transformers is located adjacent to each traction substation to supply electricity.

(2) Improvements for the 200 km/h Case
(Countermeasures for Regenerative Brake Current)

In modern electric traction, regenerative braking is usually applied to save energy and reduce the weight of vehicle traction equipment. Most of the regenerated energy is utilized by other trains in a parallel circuit. However, in the case of a direct current system, one of the following three methods is applied to absorb remaining energy.

(a) Installation of inverters at traction substations to return the energy to transmission lines.

(b) Installation of resistors and thyrister switches at substations to absorb the energy at substations.

(c) Installation of resistors on locomotive to absorb the energy when the voltage of overhead equipment increases.

From the standpoint of energy savings, (a) is most preferable. In the case of CMK's flat alignment, brakes are usually applied only at special locations as seen in Fig. 3.3.10, where regenerative braking currents are shown by negative value.

Inverters with 2,500 kw capacity are to be installed at the following substations:

Budy Zoiny 9.7km, Secemin 166.3km and Zawiercie 224.0km from Grodzisk station

A spare set for each location is not needed, since if regenerative braking is lost, air brake will instantaneously take over. However one spare set will be prepared to reduce the chances of taking over by air brake.

(3) Improvements for 250 km/h Case

a) Countermeasures for regenerative brake current

The same countermeasures as in the 200km/h case must be employed. Namely, inverters with 2,500kw capacity are to be installed at the following substations:

Budy Zoiny 9.7km, Secemin 166.3km and Zawiercie 224.0km from Grodzisk station respectively and one spare set.

b) Increase of capacity of traction substations

Instantaneous loads of substations sometimes increase as much as 286% of the rated capacities. A set of rectifier having a 2,500kw capacity is to be added to the 13 substations between Grodzisk and Zawiercie.

3.3.5 Signaling and Telecommunication

1) Signaling

(1) Present Status

Warszawa Central - Grodzisk 29.5 km

These is an automatic block with 3 signal aspects for both directions.

Grodzisk - Psary - Zawiercie 224 km

There is an automatic block with 4 signal aspects for both directions. 10 intermediate stations are equipped with relay interlockings. Centralized Traffic Control (CTC) has been installed and under testing. It is conceivable that present relays for the interlockings need to be changed to raise reliability for actual use of CTC.

Zawiercie - Katowice 44 km

There is an automatic block with 3 signal aspects for both directions.

(2) Improvements for the 160 km/h Operation]

a) Blocking

An automatic block with 4 aspects, the same as the present system on CMK, will be employed. However, to ensure the functioning of ATP described in b), signaling rule is to be modified and speed limits for each aspect of automatic block signal are set as follows:

Sequence of signal aspects	:	G	- FG	- Y	- R
Speed limits in km/h	:	160	160	110	30(0)

(Note)
It was thought that such speed limits for the signal aspects would affect traffic capacity, but, based on actual results, this was found not to be true.

b) Automatic Train Protection System (ATP)

ATP with the following functions will be employed.

(a) 600m before a signal, signal aspects are to be transmitted to the driver's cab.

(b) When train speed is more than the limit upon passing a signal, the brake is automatically applied.

(c) 600m before a Y signal, if running speed is found to be dangerous, the brake is automatically applied.

(d) 600m before a red signal, a distance - speed pattern is generated at the locomotive, and if the running speed is found to be more than the speed given by the pattern, the brake is automatically applied.

Transmission of information from the wayside to the locomotive is realized by one of the following three methods.

(a) Frequency shift type ground spots are installed 600 m before signals and close to signals.

(b) Transponders are installed 600m before signals and close to signals.

(c) Short distance audio-frequency track circuits energized near signals are installed and detected by receivers on the locomotive from 600m before signals. The location from which a locomotive receiver detects information can be precisely determined by placing series resonance circuit between two rails at the location.

As for lines other than CMK, lines for 160km/h operation will employ a common ATP, and major lines operating at 120km/h or more will employ ATP with the same principle. Therefore, even in "no improvement case", above mentioned improvement a) and b) are to be implemented.

(3) Improvements for the 200 km/h Case

a) Blocking

Automatic block with 5 aspects will be employed.

Sequence of signal aspects	:	GG	- G	- FG	- Y	- R
Speed limits in km/h	:	210	210	160	110	30(0)

Minimum distance between automatic signals : 1,300 m

b) Automatic Train Protection System (ATP)

The same system as above described ATP for 160km/h operation will be employed.

(Note)
ATC or a continuous cab signal could be employed as same as the 250km/h case, but the costs are much higher and the through operation of locomotives

might be affected. On the other hand, a conventional automatic block with improved ATP was found to meet 200km/h operation quite well. It could be possible to use a four aspect automatic block with improved ATP for the 200km/h case. However, in this case, careful studies on brake distance and problem that the same aspects indicate different speed limits depending on lines will be required.

(4) Improvements for the 250 km/h Case

ATC (Automatic Train Control) or a continuous cab signal with ATP, both without wayside signals, should be employed.

Sequence of speed indications : 260 - 210 - 160 - 110 - 30 - 0

(an example of Shinkansen)

Distance between the boundary of the speed indications is decided by normal brake distance that includes the necessary margins. In the case of ATC (Shinkansen), train speed is automatically decreased to the indicated speed. In the case of continuous cab signal with ATP (TGV in France), the driver regulates the speed, and if ATP finds the speed is too high, the automatic brake is applied.

Transmission of information from the wayside to a locomotive is realized by an audio-frequency track circuit current in many cases. It should be noted that discussion on standardization of future high-speed train control system for European railways has started recently.

2) Telecommunication

(1) Present Status

The Major telecommunication equipment along CMK line is as follows.

Trunk cable	:	Paper insulated lead sheathed with 68 pairs of conductors 1.2mm square or 0.9mm square
Multiple cable carrier system	:	1 system with 12 channels
Dispatcher telephone	:	2 systems, one for train dispatchers and one for traction dispatchers
Movable radio	:	150 MHZ simplex, for drivers and for maintenance