CHAPTER - VIII

CONSTRUCTION PROGRAMME, MANPOWER AND PLANT PLANNING

8.0 General

This chapter describes the construction methodology and equipment planning for construction of the main components of the project. The construction methodology for each type of structure has been described under the relevant sub sections of this chapter. The type and sizes of the equipment to be used have also been indicated while describing the construction methodology. The number of machines required for construction of each component of the project has been worked out and total requirement for each type and size of the major equipment has been arrived at after preparing the construction/ deployment schedule for main components of the project. In case, the work is executed through award of contract, the contractors in all probability may suggest their own construction techniques and equipment for execution of the job based on equipment actually available with them. The tentative requirement of machines as worked out herein will help in analysis of rates of works, cost estimation and evaluating the reasonableness of the participating bidders, construction techniques and equipment, within overall construction schedule and cost estimate.

8.1 Main project components

The Kosi-Mechi Link Project envisages diversion of part of surplus water of Kosi river through existing Hanuman Nagar barrage to Mahananda basin. Main components of the project involve remodelling of existing EKMC upto 41.30 km and construction of a new canal from RD 41.30 km to 117.50 km long. The FSL of link canal at head is 74.371 m and at tail end is 54.238 m.

The water available at Hanuman Nagar barrage will be diverted through a 117.50 km long link canal to Mahananda basin and for enroute utilization. In this entire length of the canal, 14 syphon

aqueduct, 9 canal syphon, 9 cross regulator, 28 head regulator, 9 pipe culverts and 42 road bridges and 3 escape are required to be constructed.

8.1.1 Salient features of main components of the project are given in Table 8.1.

Table: 8.1

Salient features of main components of the project

Sl. No.	**Particulars**	
1.0	**General**	
1.1	Name of project	Kosi-Mechi intrastate link canal
1.2	Purpose	Irrigation
1.3	River-Basin	Kosi and Mechi
2.0	**Hydrology**	
a	Catchment area of Kosi basin upto existing Hanuman Nagar barrage	61792 sqkm
b	Design flood of the existing barrage	26900 cumec
c	Annual yield at 75% dependability at Hanuman Nagar barrage	43972 MCM
d	Annual water balance at Hanuman Nagar barrage at 75% dependability	27864 MCM
3.0	**Head regulator**	1 No. Existing
4.0	**Link canal**	
I	Length	117.50 km
a	Existing EKMC	41.30 km
b	New canal beyond existing canal	76.20 km
	Total (a+b)	117.50 km
II	Flow	Gravity
III	Lining	Concrete lined fully
IV	Design discharge at head	573 cumec
V	Design discharge at tail	27 cumec
VI	Full supply depth at head	3.50 m
VII	Full supply depth at tail	2.00 m
VIII	Bed width at head	131.5 m
IX	Bed width at tail	15.00 m

X	Side slopes	1:1.5
XI	Bed slope of link canal	1:11,000 and 1:12,000
XII	Velocity at head	1.180 m/sec.
XIII	Velocity at tail	0.706 m/sec.
XIV	FSL of canal at head	74.371 m
XV	FSL of canal at tail end	54.238 m
XVI	No. of structure across link canal	112 Nos.
a	Bridges	42 Nos.
b	Syphon aqueduct	14 Nos.
c	Canal syphon	9 Nos.
d	Cross regulator	9 Nos.
e	Head regulator	28 Nos.
f	Hume pipe culvert	9 Nos.
g	Escape	3 Nos.

8.2 Basis for study

8.2.1 General

Methodology adopted for construction of Kosi-Mechi Link Project keeping in view the construction schedule, the compatibility of the construction equipment to site conditions and the quantities as well as the utilization factor of the equipment within the scheduled construction period. Number of machines required for construction of project has been worked out and the total requirement for each type and size of machine for the project as a whole.

Mechanized construction has been planned for almost all types of construction jobs so as to achieve consistent quality at a faster rate and also to minimize the requirement of skilled manpower.

Sequencing of construction activities, wherever possible, has been attempted in such a way that equipment from one activity, on its completion can be shifted to the other. This way, the total requirement of equipment at a time would be reduced and also, sufficient utilization of equipment on the project would be ensured.

8.2.2 Construction material sources

Locations of different borrow areas and quarries for construction material have been described in the Chapter-IV Survey and Investigation.

Borrow areas with minimum lead should be utilized during canal construction. For the purpose of equipment planning, average distance of borrow areas from canal structure has been considered. However, during construction, appropriate decision may be taken to select the borrow areas which meet the requisite specifications.

Construction material for concrete, viz. sand/fine aggregate, coarse aggregate, for both non-wearing and wearing surfaces are also located in the vicinity of canal structure site.

The area for disposal of excavated material has been considered at an average distance of 2.0 km from the canal site for equipment planning purpose.

8.2.3 Basic considerations

Based on past experience, about 8 working months in a year are available in the area where the project is situated. Other projects in the region have also been planned with this consideration. However, all the surface works are proposed to be executed in two shifts.

8.2.3.1 Scheduled working hours

The requirement of the equipments has been planned in reference to the "Guidelines for preparation of Detailed project report of Irrigation and Multipurpose Projects, MoWR, Government of India, 2010". Equipment planning for calculating requirement of equipment is carried out based on the number of working days available, which further depends upon climatic conditions of the project area. In the present scenario, the monsoon sets during June and continues till October in the project area. For equipment planning purpose the monsoon season has been considered from 15th June to 15th October. Thus, for over ground works i.e. appurtenant works a working season of eight months would be available. The scheduled working hours considering 25 working days per month is given in Table 8.2.

Table 8.2

Schedule working hours

Type of work / Type of shift	Schedule working hours
Single shift work/day	8x25x6 = 1200
Two shift work/day	8x25x10=2000
Three shift work/day	8x25x12.5=2500

Two shifts working of equipment is normally considered most economical in view of the night cost of three shift working on account of availability of equipment and higher stand-by equipment requirement. Thus planning for construction of all the components of Kosi-Mechi link canal project works have been carried out based on two shifts per day working. Accordingly, schedule working hours in a year with 200 available working days should be taken as given in Table 8.2.

Provision of standby equipment has been considered as follows:

1. Single shift working 10%
2. Two shift working 20%
3. Three shift working 30%

8.2.3.2 Construction period

The schedule of construction of the link project is planned for a period of 5 years. The infra-structural development like project colonies, approach roads, workshop, haul roads, stores, office buildings, etc. pre-construction surveys and investigations, preparation of design/specifications and tender documents have been proposed to be completed during first quarter of second year. In case the works are to be executed through award of contract, it is planned to award contracts for all major works by 1st quarter of second year. However, some of the works like canal may have to be undertaken from the 4th quarter of the 1st year itself and therefore, award of work for these works may be planned accordingly. Remodelling of the existing EKMC is proposed to be taken up reachwise from its tail end in such manner so that loss due to existing irrigation may be minimized.

The work of infrastructure facilities like project colonies, approach roads, workshop, haul roads, stores, office building etc. will be completed in 1st year itself. Some of these activities will continue for some time during 2nd year also.

The construction of all civil structures is proposed to be completed within 1st quarter of year 5. The erection, commissioning and testing of units would be required to be planned so that full benefits could be accrued at the end of proposed construction period.

A total construction period of 32 months have been earmarked for completion of main canal including remodelling of existing canal, branch canals, distributaries and other canal structural like aqueduct, syphons, hume pipe culverts, road bridges and railway crossings.

Though, construction period of the link project has been considered as 5 years, but with the introduction of the latest technology, modern management techniques and accelerated pace of funding it can be further reduced.

The detailed construction schedule for the project in the form of a bar chart is attached as Annexure 8.1.

8.2.3.3 Construction methodology and equipment

The construction methodology and equipment planning along with construction programme for different components of the project have been described in the succeeding sub-sections.

8.3 Construction programme

8.3.1 Kosi-Mechi link canal

The construction of Kosi-Mechi link canal and associated branch canals involve surface excavation in some reaches and placement of fill material in others. For fill reaches, spreading, wetting and compaction of the fill material will have to be undertaken. In addition, the canal will be lined using cement concrete of M15 grade (1:2:4). The quantities involved in construction of the link canal and associated branch canals are shown in the Table 8.3.

Table 8.3
Quantities involved in construction of the Kosi-Mechi link canal and associated branch canals

Description of work	Type / Material	Quantity	Unit
Excavation	Common soil	4616529	cum
Fill placement	Common soil	9215841	cum
Lining	Concrete	717018	cum

8.3.2 Remodelling of EKMC

The construction for remodelling of EKMC is proposed from the IInd year. Methodology and equipment for the activities involved in the construction of Kosi-Mechi link canal and associated branch canals will be similar to those required for remodelling of EKMC and have been described in the relevant section.

Table 8.4
Estimation of hourly quantity of excavation

Description	Soil excavation
Total volume	4616529 cum
Time period	24 months
Shift proposed	2 number
Total operational hours	6000
Volume to be handled in-situ	769 cum/hr
Volume to be handled loose	962 cum/hr

Peak quantity 1203 cum/hour

Table 8.5
Estimation of hourly quantity of filling material placement

Sl. No.	Description	Quantity
1	Total volume	9215841 cum
2	Time period	22 months
3	Shift proposed	2 number
4	Operational hours	250
5	Total operational hours	5500
6	Volume to be handled (in-situ)	1676 cum
7	Volume to be handled (loose)	2095 cum

Peak quantity 2619 cum/hour

The equipments to be used for excavation and filling material placement with their capacity and numbers have been shown in subsequent para.

8.3.3 List of major construction plant and equipment for link canal

Based on above construction methodology, major construction plant and equipment required for construction of Kosi-Mechi link including remodelling of existing canal are given in Table 8.6.

Table 8.6
Major construction plant and equipment required for construction of Kosi-Mechi link

Sl. no.	Equipments	Size/capacity	Quantity (Nos.)
1.	Hydraulic excavator	2.5 cum	5
2.	Crawler/wagon drill	600 cum	3
3.	Road roller	8/10 t	3
4.	Front end loader	1.5 cum	5
5.	Rear end dumper	18/20 t	15
6.	Crawler dozer	180 hp	2
7.	Vibratory compactor (pad foot)	10 t	6
8.	Vibratory compactor (smooth drum)	10 t	3
9.	Water sprinkler	8000 lt.	8
10.	Tippers	4.5 cum	15
11.	Aggregate processing plant	100 tph	3
12.	Batching and mixing plant	45 cum/hour	3
13.	Mobile batching and mixing plant	18 cum/hour	3
14.	Electric winch	20t	5
15.	Concrete pump with 25m boom	38 cum/hour	3
16.	Concrete vibrator (electrical/pneumatic)		21
17.	Compressed air	4200cfm	5
18.	Grout pump	20 kg/m^2	6
19.	Front end wheel loader	2.5 cum	2
20.	Mobile crane	20t	3
21.	Transit mixers truck mounted	4.5 cum	15

8.4 Construction programme

As the main canal stretches over a significant distance, sufficient time is required to carry out detail surveys for main canal, branch canals, distributaries, minors and to finalize portions of canals for irrigation along with specific emphasis on time required for land acquisition. The contracts for all major works are to be awarded by the first year itself so that the entire basic infrastructure required for the canal construction can be completed within one year itself.

A construction period of 4 working seasons has been planned starting from beginning of 1st quarter of year 2. A period of 32 months excluding the monsoon period have been considered necessary to complete the construction including the lining of link canal. The construction work of CD/CM structures is proposed to be carried out during the same period.

8.5 Deployment schedule

Based on equipment planning and construction programme described in preceding Sections, a construction schedule for whole of the project has been prepared in the form of a Bar Chart and is placed at Annexure 8.1. Keeping this construction schedule as one of the major criteria, a deployment schedule of major construction equipment that would be required for the project is shown in Annexure 8.2. The number of equipment shown in the list has been arrived at after scheduling the equipment in such a way that minimum number of equipment, in general, would be needed. The basis for planning, indicating the type of equipment to be used, has already been dealt with in the respective sections and sub-sections corresponding to different items of the structures. As the deployment schedule may differ depending upon the number of executing agencies, the total number of equipment required will have to be reviewed at the time of project execution.

8.6 Total requirement of major construction equipments

A list of major construction equipments and plants, which would

be required for the project, is shown in Annexure 8.3. The latest budgetary prices of the equipment have been indicated in the list which could be utilized for working out the analysis of rates as required. The total cost of construction equipment has been worked out as Rs 3487.00 lakh.

The provision on this account will not be included in the sub-head Q–Spl. T and P of Cost Estimate in case the works are to be executed by the contracting agencies.

The planning for key material required for the project is carried out in the following manner.

Sl. No.	**Material**	**Quantity**	**Yearwise requirement (%age)**				
			I	II	III	IV	V
1.	Cement	35122 cum	-	30	35	30	5
2.	Steel	4917 MT	-	30	35	30	5
3.	Explosives	-	-	-	-	-	-

The cement and steel could be transported upto nearest railway stations, Forbesgani, Araria and Kishanganj, which are situated at a distance of 5, 40 and 25 km respectively from the proposed link alignment. The Bokaro steel city, which is nearest source of steel from the project site is located at a distance of 600 km from above railway stations. The other materials like sand and coarse aggregate could be transported through the local roads.

8.7 Organizational set up

The project will be implemented under an organisation set-up headed by an officer of the rank of General Manager. The works will be executed under the overall supervision of an officer of the rank of Chief Engineer who will report to General Manager. In addition, there will be four officers of the rank of Superintending Engineer to assist General Manager viz., Director (Administration), Director (Finance), Director (technical) and Superintending Engineer (Quality Control). Each will be

assisted by appropriate subordinate officers and staff. The organisation chart for the project is appended as Annexure 8.4.

There will be one Chief Engineers for the project to look after the entire project works. There will be supported by three or four officers of the rank of Superintending Engineer who will be heading the field formations of circles. Each circle will have three to four division offices which will be headed by the officers of the rank of Executive Engineers. Executive Engineers in turn will have Assistant Engineers as their subordinate officers who will maintain Sub-Divisional offices.

Chief Engineer will be responsible for execution of works related to entire project work. The Superintending Engineers will be responsible for civil designs and construction of the project. They will be supported by appropriate subordinate officers as elaborated under the organisation chart.

Detailed manpower requirement has been indicated in Annexure 8.5 to 8.7.

8.8 General purpose equipment and inspection vehicles

In case the works are to be executed through award of contract, the general purpose equipment for infra-structure works and inspection and transport vehicles, which are required to be procured and used by the project owners for the project have been estimated and indicated in the Annexure 8.8. The total cost of general purpose equipment and inspection vehicles has been worked out as Rs. 545 lakh.

8.9 Year wise allocation of cost

The total cost of project including remodelling of EKMC construction of new canal is worked out to be Rs. 2903.25 crore. The yearwise allocation of cost for the project is given in Annexure 8.9. The abstract of the allocation is given in Table 8.7 below.

Table 8.7

Year	Allocation (in lakh)	Allocation (in %)
I	22307.47	7.68
II	71286.55	24.56
III	95825.57	33.01
IV	77615.62	26.73
V	23290.21	8.02
Total	**290325.42**	**100.00**