**MASTER PLAN**

**FOR**

**DRAINAGE OF STORM WATER DRAINAGE OF THE SHAHDARA BASIN**

**IN**

**UNION TERRITORY OF DELHI**

****

**MASTER PLAN ORGANISATION**

**FLOOD CONTROL WING**

**DELHI ADMINISTRATION**

**1976**

**MASTER PLAN FOR STORM WATER DRAINAGE**

**OF SHAHDARA BASIN IN**

**THE UNION TERRITORY OF DELHI.**

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MASTER PLAN OF DRAINAGE FOR SHAHDARA BASIN

1.0 Topography and land use

The Shahdara basin covering about 30,000 acres of land in U.T. of Delhi is situated on the Eastern Bank of the river Yamuna. The basin is bounded by the river Yamuna on the West, Hindan River on the east and U.P. on the North and South. A map showing the general features of the basin is enclosed at Appendix S-1. G.T. road passes through the centre of this basin from West to East. Parallel to G.T. road is the Northern railway main line towards Saharanpur (U.P.) the arterial highway and N.H. Bye Pass No.24 also pass through the basin.

The whole of the Shahdara basin in Delhi is below the high flood level of the river Yamuna and it used to get, in earlier days, flooded every year. In the year 1955-56, marginal embankments (Shahdara Marginal Bund and Left Marginal Bund) were constructed to protect this basin from the ravages of floods. Alignments of these bunds were decided by the C.W.P.R.S., Poona.

Total catchment area for which drainage arrangements in this basin are to be provided is 36,660 acres. This is classified as below:-

Delhi U.P. Total

Urban 5443 1716 7158

Rural 2361 5331 7693

 7804 17047 14851

2. Sub-soil Water conditions:-

The Flood Control Department of Delhi Administration has been maintaining a number of sub-soil water observation points fixed all over the Union Territory of Delhi since 1972, at an approximate grid of 1 Km. Based on the data collected for 1973 & 74, contour plans for maximum and minimum water tables in the Shahdara basin have been prepared and are enclosed as Appendix S-3&S-4. The plan of maximum water tables has been prepared on the basis of the data observed during the monsoon period and the minimum water table during the pre-monsoon period. It may be seen from these plans that the maximum water table, varies from 0 to 2 m. below the ground level except at the north-East corner of the basin, where it is about 3 m. Minimum water table varies from 2 to 3 m, below the ground level. The main problem in Shahdara basin is high water table as contrary to the right bank of Yamuna. Therefore, all drainage congestion must be cleared and there is no necessity of retaining any ponds for regeneration of sub-soil water table as in other basins.

According to the report of Geological Survey of India, nearly whole of Shahdara basin has shown a rise in its water table. During the 10 years period of 1961-70, this rise was of the order of 0.29 metres to 2.84 metres. An accumulation of the ground water in storage of the order of 20 million cubic metres (approximately) has taken place during this period. This indicates that on an average every year two million cubic metres of water is accumulated. This phenomenon can be explained by way of more of recharge and less of draft. In Shahdara basin, due to progressive urbanization, the demand of water has decreased because of reduction in irrigable areas.

3.0 JURISDICTION OF M.C.D. DELHI ADMINISTRATION

 REGARDING DRAINGE ARRANGEMENTS.

 In the DDA Master Plan for Delhi, this basin is proposed to be developed as a city, with a population of over 7 lakhs. At present, all the internal drains( numbering about 15) within the urbanized area are being maintained by MCD. A pump house with installed capacity of 140 cusecs ( 4 pumps of 35 cusecs each) situated at R.D, 0.0m of S.M. Bund and several other pump houses installed at different places are under their control. The drainage of the rural area, north of arterial highway and South of N.H. Bye pass are at present being looked after by the Flood Control Department. The Flood Control Department has in 1972, taken up the work of constructing two arterial drains i.e. drain No. I and drain No. II passing through the centre of the Shahdara basin, starting from the Northern border and ultimately falling into the river Yamuna, downstream of the proposed Okhla Barrage in U.P. near village Chalera.

The Shahdara basin is being rapidly urbanized. Almost all the existing urban drains have practically become inadequate and need to be remodeled. It is felt that the control of maintenance and remodeling of the entire storm water drainage system of the Shahdara basin should be under one authority, so that they can be had responsible for any problem in this connection. Since the construction of the arterial drain is taken up by the F.C.D. the remodeling & maintenance of the tributary drains should also be preferably under the same department.

4.0 PROBLEM OF DRAINAGE CONGESTION IN THE SHAHADARA.

As mentioned in the para 1.0 above, the Shahdara basin has been protected from the floods by a 39200 ft. (11.95 Km.) long marginal embankment. This embankment is known as Shahdara Marginal Bund above G.T. Road and Left Marginal Bund below G.T. Road.

During low-flood period in the river, most of the runoff from the area North of G.T. road finds its way by gravity into the river Yamuna through regulator at R.D-Om whereas during even an average flood stage in Yamuna, the entire runoff from these areas has to be pumped into the Yamuna and the failure of pumps results in flooding of the area.

The area lying South of G.T. Road, is drained into the Disused channel which has its outfall into the Hindan Cut canal. Since the full supply level of the Hindan Cut canal is higher than the average N.S.L. being drained, and also because Hindan Cut runs from November to June during the non-monsoon, the drainage water continues to stagnate in the area.

Thus the areas both in the North and South of G.T. Road have no proper drainage. Below are given a few of the areas which suffer from drainage congestion.

4.1 SHASTRI PARK & SURROUNDING AREA

At present these areas are drained by Gokulpur drain which falls into the river Yamuna through the regulator gate at R.D. O of the Shahdara Marginal Bund. The sill level of this regulator is R.L. 663.00 ft., whereas the river Yamuna reaches flood stages of the R.L. 664.00 at this point. This stage of the river does not permit opening of the regulator gate to discharge Gokulpur drain into the river. Although this drain is connected to M.C.D. pump house having 4 pumps of 35 cusecs capacity each, the M.C.D. authorities give priority to the storm water of Navin Shahdara area which comes through G.T. Road drain. Hence, this results in flooding of Shastri Nagar and the areas surrounding it.

4.2: Navin Shahdara:-

This being a low lying area cannot be drained by gravity. Therefore, the storm water from this area is pumped to Sham Lal College pond ( Chintaman pond), which is connected by link drain to the existing 52 cusecs drain along E.Y.C. on one side end, and to Chorpulia culvert under the Northern Railway line on the other side.

Now the Chorpulia discharges into the pounded areas of Silampur (along the N. Railway line) which aggravates the already existing drainage congestion of the area.

52 cusecs drain discharge into the G.T. Road drain, which carries the entire discharge to M.C.D. pump house at R.D-O of S.M. bund for pumping into the river Yamuna. Occasional failure and untimely functioning of these pumps results in submergence of the Navin Shahdara area. Moreover, the link drain to 52 cusecs drain has been blocked by the DDA as it passes through the centre of the park being developed by them. This resulted in serious drainage congestion during the flood season of 1975.

4.3: JYOTI COLONY OF LONI ROAD:

Jyoti colony has a haphazard construction of houses with no drainage links causing stagnation in the area during monsoon.

4.4:- VILLAGES; SABEPUR, SADATPUR, USMANPUR.

As shown in the plan of Appendix S-1 these villages are located in the bed of the river Yamuna and on the West of S.M. Bund. Therefore, these villages invariably get marooned due to rise in level of the Yamuna during monsoon, causing dislocation of communication. Hence during floods, rescue operations are usually made for these villages.

4.5 RADHEYPURI DRAIN

 This drain carries part of the discharges of Navin Shahdara (through Chorpulia) Kasturba Nagar (Through Kasturba Nagar drain) and Krishna Nagar (through Krishna Nagar drain) and ultimately meets the disused canal. Radheypuri drain, being inadequate to carry such heavy discharge, overflows or breaches during monsoon, flooding Jagatpuri and other neighboring colonies. In the flood season of 1975; a branch in Radheypuri drain resulted in severe flooding of Jagatpuri areas. This breach occurred due to failure of side wall, because inhabitants of the areas had removed earth from the back of the wall.

* 1. DISUSED CHANNEL

All the drains south of G.T. Road, meet disused channel which further outfalls into the Hindan Cut. Disused channel is mostly passing through pipe culverts at the road crossing. These pipe culverts normally get chocked due to siltation. During the flood season of 1975, at the crossing of road No.57, out of five pipes only two pipes were partially working. This resulted in blocking and overflowing of all the drains such as Geeta Colony drain, Patpar Ganj drain, Khureji Khas drain and Radheypuri drain and all these areas were severely flooded.

* 1. STAGNATION DUE TO EXISTING PONDS.

 There are a number of ponds in this block, most of which have been created by the people for the purpose of raising the plinth of their houses. These are indicated in the plan at Appendix S-1.

Major ponds such as Maujpur, Silampur, Jwala Nagar and Sham Lal ponds are connected to the nearby nallas by link drains. These link drains discharge only the surplus water of the ponds during the monsoon. Rest of the water remains stagnant in the ponds. During non-monsoon season, sullage from the areas keeps on collecting in these ponds, causing health hazard. Other ponds causing health hazard in a similar way are in Jhilmil Colony, Kasturba Nagar, Karkar duman etc.

4.8 STAGNATION DUE TO IMPROPER AND UNTIMELY DESTINATION OF DRAINS.

Many of the drains become ineffective due to siltation. Whenever desilting is done, the silt is just deposited on the banks which again falls into the drains in no time due to rains and other agencies.

* 1. LALITA PARK ( LAXMI NAGAR EXTENSION).

 This colony has come up in a local depression and is not provided with any drain to drain off storm water. Therefore, storm water remains stagnant around the houses for many days.

* 1. Silampur and surrounding areas

 This area is having a number of ponds along the northern railway line. These ponds are connected to the Krishna Nagar drain on one side and Kailash Nagar Nallah on the other side. But as these ponds have been created by the public for the purpose of raising the plinth of their houses or by removing earth for some other purposes, bed of these ponds is lower than the invert level of connected culverts. Therefore, most of the storm water remains stagnant in these ponds. Moreover lot of debris and other wastes are thrown by the residents of the areas at the point just upstream of the connecting culverts. This blocks the flow of the storm water during the rainy season, resulting in ponds’ overflowing their banks and spreading to the residential limits of the areas.

4.11 Vinod Nagar and Bhuapur.

Both these areas are low lying and are not provided with any drain to drain off the storm water during the rainy season.

4.12 Shakarpur Khas.

This area is not having any drainage system to dispose of the storm water. During the rainy season water collects into the local depression wherever it can form its course towards these depressions, or otherwise it remains stagnant in the residential areas which ultimately results in flooding the whole area. Existing local drain along the road of G and H block is too inadequate and is not connected to any major Nallah to dispose of its discharge. Therefore, during the dry season, waste water from residential areas remains stagnant in it and during the rainy season, it overflows its banks, spreads over the road and its surroundings.

 4.13 STORM WATER ENTERING FROM NEIGHBOURING STATE (Ref. catchment plan)

Storm water to the extent of 2839 cusecs (1489 cusecs from area north of arterial highway and 1350 cusecs from areas of Ghaziabad improvement trust) enters the Shahdara Block as shown in the plan at Appendix S-1. This further enhances the problem of drainage congestion in the block.

5.0 PROPOSED DRAINGE SYSTEM REMODELLING OF EXISTING DRAINS.

After a thorough study of the drainage problems and topography of the area, it has been found feasible to drain the complete Shahdara Block to the river Yamuna by gravity flow.

A plan showing the proposed drainage system is enclosed/Appendix S-1. The main arterial system will follow the drain No.I and II, drain No.1 starts from North of arterial highway and drain No.II starts from North of G.T. road ( near U.P. border) Drain No.I and II meet at the upstream of the junction of road No.56 and 57 ( at point marked as K in the plan at Appendix S-1) and ultimately the combined drain will run along the Hindan cut canal and then will fall into river Yamuna, about 500 ft. downstream of the proposed Okhla Barrage near the village Chalera in U.P.

All the existing drains are to be remodeled to meet drain Nos. I & II as shown in the plan.

Broadly speaking the area for the drainage system can be divided into five blocks as follows:-

1. Area north of arterial highway,
2. Area in between arterial highway and G.T. Road/.
3. Area between G.T. Road and N.H.No.24 Bye pass.
4. Area between National Highway No.24 Bye Pass and Hindan Cut Canal.
5. Area South of Hindan Cut Canal.

The detailed description of the proposed drainage system is as given below:-

* 1. Block-I Area North of arterial highway

The area north of arterial highway is bounded by Shahdara Marginal Bund on the West, Jaoli Escape and a ridge on the North, a demarcating ridge between the catchments of Yamuna and Hindan Rivers on the East and Arterial Highway on the South.

A total area of 13,079 acres out of which 3207 acres in Delhi and 9872 acres in U.P. is to be catered by the various drains, which will ultimately discharge into the main peripheral drains namely drain No.I and II. An area of 9407 acres will be drained by drain No.I and the rest of drain No.II. 25% of this total area has been taken as urban as per recommendations of the Technical Expert Committee for Shahdara Drainage Scheme.

Drain No.I will start from Delhi-U.P. border at point ‘A’ where the discharge from U.P. areas will be intercepted. It will follow the course of Banthala drain. Karawal Nagar drains from the Delhi-U.P. border will also meet drain No.I at point B. The area on either side of drain No.I in this block will be drained into it through

Gokulpur drain (escape) by reversing its slope.

Area to the East of S.M. Bund will be catered by Beharipur drain, Bund drain and the lower reach of Gokulpur drain (escape). Discharges from these drains are presently proposed to the disposed to the river Yamuna by the 100 cusecs Pumping station (2 Pumps of 50 cusecs each) being installed by the Flood Control Department of Delhi Administration at R.D. 13.75 S.m. Bund. Capacity of this pump house is 2x50 cusecs. But in the final phase of the scheme, these drains are proposed to be connected to the Gokulpur drain running along the S.M. Bund. The existing pumps will be used only in emergencies.

 The area East of Shahdara-Saharanpur Road is presently under cultivation through Kotwalpur distributory. Whenever this area is developed the discharge from this portion can be diverted to S.S. Light Railway Drain which will ultimately meet drain No.II.

* 1. Block-II Areas between arterial highway and G.T. Road.

Total area in this block has been taken as urban. Areas on the East of S.m. Bund and West of E.Y.C. are proposed to be drained by Gokulpur drain and G.T. road drain.

As shown in the plan at Appendix S-1, Gokulpur drain has been diverted at point Q to meet the existing G.T. Road drain at point Z which will be remodeled to the required X-section to carry the discharge of Gokulpur drain to the drain No.I at point F (junction of road no.66 and G.T. road). Existing reach of Gokulpur drain from point Q to R.D. ‘O’ of S.M. Bund will be retained so that it may be utilizing in case of emergency when the flow towards the proposed direction gets blocked.

Lower reach of G.T. road drain from M.C.D. Pump House to point Z is also proposed to be retained, for utilizing in emergency, but its bed slope is proposed to be reversed suitably to meet the proposed bed of Gokulpur drain at point Z.

It is recommended that all the low lying areas in Maujpur, Brahampuri, Shastri Nagar, Chowhan Bhangar, Jagarabad and Ghonda should be filled up with Yamuna sand.

Areas on the East of E.Y.C. and West of S.S. light Railway are proposed to be drained by Jyoti Colony drain, Balbir Nagar drain, Bhatha road and G.T. road drain No.I. All these drains discharge into Drain No.I. Navin Shahdara being a low lying area cannot be connected to G.T. road drain by gravity. Therefore, present arrangement of M.C.D., that is of pumping the storm water to Shyam Lal college pond is proposed to be continued. Sham Lal College pond is connected to G.T. road drain through a suitable pipe line connection. M.C.D. P/S at Loni Road will continue to pump the storm water of Bhatha drain to G.T. road drain. G.T. road drain No.I at its R.D. 1300 m to RD 1500 m. Portion of the existing G.T. road drain from R.D. 1300 to E.Y.C. will drain off the areas. East of E.Y.C. and West of proposed road No.57.

Areas on the East of S.S. Light railway upto U.P. border are proposed to be drained by S.S. Light railway drain and G.T. road drain No.II (from U.P. border to Shahdara-Saharanpur road). But these drain discharge into Northern railway line drain at its RD (O), which further discharge into drain No.II.

* 1. Block-III Area between G.T. Road and N.H. 24 Bye Pass. Total area has been taken as urban.

Area south of disused channel and North of N.H. Bye Pass No.24:-

In this zone low lying area of Lalita Park (Laxmi Nagar Extension) is proposed to be connected to disused channel by a proposed drain along L.M. Bund. Shakarpur Khas is proposed to be connected to Shahdara link drain through culvert under goods avoiding railway line. Other drainage congested areas of Vinod Nagar and along N.H. Bye Pass No.24 are proposed to be connected to Ghazipur drain by proposed drain along N.H. by Pass No.24.

5.3.1 Area bounded by Road No.56 and Road No.57

 Presently this area is mainly served by Kasturba Nagar drain which joins Disused channel through Radheypuri drain. It is now proposed that Kasturba Nagar drain will be intercepted to meet drain No.I at R.D. 12700. As this area is proposed to be developed by DDA, additional drains necessary will be suitably connected to Drain No.I & II when the area is fully developed. It is however necessary that all the ponds and depressions in this zone should be filled up above 202.5 m and the drainage system of this area must be planned by DDA who have proposed to be develop it.

The slope of the disused channel in this portion is also proposed to be reversed to meet Drain I & II.

5.3.2 Area between Road NO.57 and L.M. Bund

 This area is presently served by Radheypuri drain, Krishan Nagar drain, Khureji Khas Drain, Gita Colony Drain, Patparganj drain and disused channel.

Krishan Nagar drain carries the discharge of Krishan Nagar and Ram Nagar and meets the disused channel through Radheypuri drain. It is now proposed to remodel the Krishan Nagar Nalla and divert it to join drain No.I, through the culvert at RD 12700.

 Now that the discharge of the K.N. drain and Kasturba Nagar drain are proposed to be diverted to drain No. I, the Radheypuri drain will carry the discharge of only its own catchment and join Disused channel Gita Colony drain, Patparganj drain and Khureji Khas drain will continue to discharge into the Disused channel which will finally meet Drain No.I.

* 1. Block No. IV: Area South of N.H.24 bye pass upto Hindan cut canal.

From the contour plan (Appendix S-2 ), it may be seen that this is the lowest area in the whole of Shahdara basin. This N.G. K Murthy Committee, in their report published in July, 1973 on Shahdara Drainage Scheme has stated that “Block-IV being the lowest and Southern most should be rural by strict enforcement. The development of the block will not only cause serious stagnation of the storm water in the block itself, but will back up and blockade storm water in Block-III from flowing downwards. However, as prohibitory orders do not obtain full compliance, the administration should take precautionary steps of

a) Having the area detailed contour surveyed to 1 foot interval.

b)Have depressions demarcated (and acquired, if necessary) and reserved as absorption ponds of local storm water runoff upto pre-determined levels.

c) Inescapable building activity in the balance area should enforce high plinth level not less 3 feet above ground.

It is observed that the Delhi Development Authority have already started developing this area, in spite of the above warning from N.G.K. Murthy Committee. If, however, development work is inescapable due to shortage of available area elsewhere, it is recommended, that all the low lying areas within the urbanisable limits should first be raised, by at least 3’ by utilizing either (a) the earth available from the excavation of the arterial Shahdara drains, Ghazipur drain or khichripur drain, or (b) sand excavated from the Yamuna river bed, as has been done for reclamation of the salt lake area in Calcutta.

Unless the general level of area is sufficiently raised, it will remain a perpetual water logged area for all the years to come causing serious hardship to all the residents of the area. Nobody can depend upon pumping for drainage as a permanent solution due to its occasional failure and maintenance cost.

The proposed drainage system of the area will be as follows:-

The combined drain of Drains No. I & II which meet at point (junction of road no 57 & 56) will pass through this area. This combined drain called Ghazipur drain and two more drains viz. Shahdara drain and Khichripur drain are prepared to serve the area South of N.H. 24 Bye Pass. The entire discharge will outfall into the River Yamuna downstream of the proposed Okhla Barrage. As recommended by N.G.K. Committee, 25% of the area in the block has been taken as urban. If DDA is to develop further, the capacity of the drain should be properly increased.

* 1. to 5.6 Block No.V

Areas South of Hindan cut canal is proposed to be drained by a drain parallel to Hindan cut to the South of it which will join the outfall channel at RD 19500. Whole of the area in this block has been taken as rural.

6.0 Recommendations for relief in specific areas prone to frequent drainage congestion.

6.1 Shastri Park & surrounding areas:-

The drainage connection in the area has be mainly for want of proper outfall conditions of Gokulpur drain into the river Yamuna. Now that it has been proposed to be remodeled and meet drain No.I, it will relieve the drainage congestion in these areas. It is proposed that all the vacant lands are to be raised up by Yamuna sand before any further construction is allowed in this area. Even the existing unauthorized buildings are to be demolished in phases and the land to be raised by at least two to three feet and then to be returned back to the owners with development fees levied.

The M.C.D. pump house at R.D. O and the regulator are to be maintained regularly to meet with any emergency whenever required. The outfall channel for the regulator upto Yamuna low water level to be silt cleared every year before the monsoon.

* 1. Navin Shahdara:-

With the proposed connection of the Sham Lal College pond to Drain No.I, the area can be free from water congestion.

* 1. Jyoti Colony:

The stagnation of storm water in Jyoti Colony will be removed by the proposed drain along Shahdara Road, which is connected to Balbir Nagar drain. Although the natural slope is towards East yet it is proposed to intercept it before it crosses the road then divert to Balbir Nagar drain.

6.4 Jagatpuri

The problem of drainage connection of West Jagatpuri is proposed to be solved by remodeling Radheypuri drain as suggested above and that of East Jagatpuri by the construction of Drain No.I.

6.5 Lalit Park ( Laxmi Nagar extension):

As shown in the plan at Appendix S-I, it is proposed to drain off this area into Disused channel. As the topography does not permit gravity flow, runoff from this area will be first carried to the proposed sump and pump house through proposed drain along L.M. Bund and entire discharge will be pumped into disused channel.

 6.6 Shakarpur Khas

As shown in the plan at Appendix S-1 there is a road under construction which is passing through the centre of Shakarpur area. Areas on the west of this road are proposed to be drained to Shahdara link drain through a drain running parallel to this road shown in the plan at Appendix S-1. Areas on the east of this road should be connected to the existing drain along Yamuna Barrage road by providing suitable local drainage system.

6.7 Vinod Nagar and Bhuapur.

 Feasibility of discharging Vinod Nagar area to Khichripur drain was checked, it could not be done because ground levels did not permit this connection. Therefore, a drain along N.H. Bye Pass No.24 falling into Ghazipur drain has been proposed.

 These two drains will solve the drainage congestion problem of these areas.

6.8 Khichripur

 The drainage congestion in this area is owing to local depression which is proposed to be relieved by construction of Khichripur drain out falling into Gazipur drain.

6.9 Existing ponds.

A number of ponds have been created in the Shahdara block by the local people by way of digging earth for construction of houses as mentioned above. These ponds are always a source of drainage congestion and consequent health hazard especially during rainy season. All the ponds in the urbanized areas should therefore be filled up. For this purpose excavated earth from Shahdara drain or Yamuna send may be utilized.

7.0 Village affected by flooding by river Yamuna.

A few villages such as Sabepur, Sadatpur, Usmanpur & Garhi Mandu being in the river bed invariably get marooned during high levels of Yamuna, causing disruption of communications etc. Average ground levels of these villages are 207,206,204.5 & 205 respectively. These levels correspond to 70,000 cusecs flood discharge in river Yamuna in these reaches which continued for about 15 days in the flood season of year 1975. Relief operations are o be provided during this period at recurring costs, besides the discomfort and anxiety to the people of these villages.

 A Forward Bund as shown in plan at Appendix S-1 upstream of Wazirabad Barrage upto U.P. border is proposed to be constructed. Gaps in the existing M.C.D. bund should be closed. The proposed alignment of the forward bund passes on the West of villages Subepur and sadatpur which is to be connected with a bund in U.P. This will protect these villages including the adjoining areas.

This scheme has the approval of Yamuna Committee held in New Delhi dated 23-24th May, 1975. Villages Usmanpur and Garhi Mandu which are on the downstream side of Wazirabad barrage are proposed to be shifted to a sui9table site on the country sides of the L.M. Bund. The area for resettlement to be first raised above the FSL of the nearest drain proposed.

8.0 General

8.1 Desiltation of Drains

 Drains should be desilted during the period December to February, so that full section of drains is available for quick disposal of storm water. Silt removed should be disposed off far away from the bank before the rain starts in order to prevent its re-deposition in the drains. Wherever drains are proposed to be made pucca or lined, they must have properly designed walls, which can stand without earth support, to avoid mishaps.

8.2 Side walls of the drains are normally designed to withstand water pressure with earth support on the back of the wall. Therefore, in no case inhabitants of the areas should be permitted to remove earth from the back of the side walls for their use raise the plinth level of their houses.

1. Rainfall studies for Shahdara basin

9.1 Collection of data for analysis.

The Shahdara basin has partly urban and partly rural areas of U.T. of Delhi, covering a total area of 19266 acres for which drainage arrangement is to be provided. Out of this total area, 13435 acres is urban and the remaining 5831 acres is rural area. The rain gauges within Delhi Territory were earlier limited to only two stations i.e. Palam and Safdarjung. According to Reddy Committee recommendations 14-self-recording rain gauge have been installed throughout the Delhi Territory during 1973, of which two stations, at Loni and RD-O of S.M. Bund are within Shahdara basin. Besides, there are existing rain gauge stations in the adjoining states viz. U.P. and Haryana.

The 14 automatic rain gauge stations set up by Flood Control Wing are in operation only for the last 3 years i.e. from 1972 to 1975. For the frequency analysis of the design storm rainfall, both for hourly as well as for 3 day maximum, these data are considered inadequate. Therefore, for the design storm in the rural areas of Shahdara Block, the 17 years data available from manually operated rain gauge stations of Siraspur, Okhla and Hindan cut have been utilized, which represent the Shahdara Block to a considerable extent. Regarding maximum hourly design storm analysis, these datas could not be utilized being the ordinary rain gauges. Therefore, the hourly design storm analysis is done on the basis of the last 9 years rainfall data of Palam.

The particulars of the rain gauge stations which are considered for analysis for the Shahdara Block are listed below:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  S.No. | Name of rain gauge station | Type | Authority in charge | Data available  | Location | Thiess on Polygon weight age for the catchment |
| 1. | Siraspur | Ordinary | Haryana Govt. | 17 Yrs. i.e. 1958 to 1974 | Outside | 10% |
| 2. | Okhla | -do- | U.P.Govt. | -do- | -do- | 40% |
| 3. | Hindan cut | -do- | -do- | -do- | -do- | 50% |

* 1. Design of storm water

The Shahdara basin consists of a combination of both rural and urban catchments. In Chapter-I, it has been recommended that the drainage system in the rural areas of Delhi, should be so designed as to restrict flooding to a maximum period of 3 days with a return period of 5 years. The 3 days maximum rainfall series of Siraspur, Okhla and Hindan cut station are available for a concurrent period of 17 years i.e. from 1958 to 1974 which have been put to frequency analysis. The 3 days maximum rainfall corresponding to 5 years return period comes to 6.95” vide Analysis-I. For a comparative study, the point rainfall at Palam for which the data is available for a period of 24 years has also been statistically analyzed which given 3 day maximum rainfall of the order of 8.5” vide analysis-II for a return period of 5 years. Similar studies of design storm was carried out by the ready Committee in 1958 on the basis of Palam data and a figure of 8.2” on 3 day maximum rainfall for 5 years frequency was recommended.

 As regards urban drains, the major arterial drains are to be designed on the basis of five years frequency rainfall of one hour duration. Proper runoff co-efficient and Aerial distribution factors already discussed in Chapter-I are to be applied. These arterial drains will be designed from reach to reach by calculating maximum ridge by rational methods.

The medium size urban drains will be designed for ½ cusecs per acre discharge, from the respective catchments. The basis of this unit discharge has already been discussed in Chapter-I.

The unit discharge for the design of the rural drains in Shahdara block works out to 6.95 x 640 x 15 = 9.3

 12 2x3 100

Say 10 cusecs per sq. mile

This is assuming a 5 years frequency of 3 days design storm of 6.95 inches.

* 1. Rainfall dispersion factor

The study of rainfall records of recent years i.e. 1973 and 1974 for various stations spread over the whole Delhi Territory reveals that the rainfall in Delhi is quite erratic and appropriate starts dispersion factors to a point rainfall is to be applied over design storm. This has been discussed in detail in Chapter-I. In the design of the drains of Shahdara Basin, 80% a.d.f. has been adopted for the arterial drains and 90% in the case of medium urban drains. For rural catchments, a.d.f. has been neglected, since the storm analysis has been made on the basis of data from rain gauges spread over the catchment.

Analysis-I(a)

 SHAHADRA BASIN

3-day rainfall analysis for total peak rainfall in MM(Y) Rainfall.

|  |  |  |  |
| --- | --- | --- | --- |
| Year | 3 day max. rainfall  | Weighted value | Total peakRainfall. |
|  | Siraspur | Okhla | HindanCut | Siraspur | Okhla  | HindanCut |  |
| 1958 | 121.92 | 225.96 | 167.54 | 12.19 | 90.36 | 83.75 | 186.30 |
| 1959 | 177.80 | 40.54 | 65.94 | 17.78 | 16.21 | 32.95 | 66.94 |
| 1960 | 184.15 | 116.74 | 215.80 | 18.41 | 46.69 | 107.90 | 193.00 |
| 1961 | 168.81 | 175.16 | 160.18 | 16.88 | 700.00 | 80.90 | 167.78 |
| 1962 | 147.32 | 96.52 | 91.34 | 14.73 | 38.60 | 45.67 | 99.00 |
| 1963 | 171.45 | 238.76 | 180.34 | 17.14 | 95.50 | 90.17 | 202.81 |
| 1964 | 148.59 | 203.20 | 154.94 | 14.85 | 81.28 | 77.47 | 173.60 |
| 1965 | 151.48 | 132.08 | 76.20 | 15.14 | 52.83 | 38.10 | 106.07 |
| 1966 | 139.60 | 76.20 | 134.62 | 13.96 | 30.48 | 67.31 | 111.75 |
| 1967 | 170.18 | 129.54 | 162.56 | 17.01 | 51.81 | 81.28 | 150.10 |
| 1968 | 177.80 | 101.00 | 150.00 | 17.78 | 40.40 | 75.00 | 133.18 |
| 1969 | 111.76 | 116.00 | 120.00 | 11.17 | 56.40 | 60.00 | 127.57 |
| 1970 | 102.87 | 120.00 | 90.00 | 10.28 | 48.00 | 45.00 | 103.28 |
| 1971 | 172.72 | 160.00 | 140.00 | 17.27 | 64.00 | 70.00 | 151.27 |
| 1972 | 172.72 | 170.00 | 130.00 | 17.27 | 68.00 | 65.00 | 150.27 |
| 1973 | 73.56 | 71.00 | 129.00 | 7.35 | 28.40 | 64.00 | 100.50 |
| 1974 | 120.50 | 197.00 | 116.00 | 12.05 | 78.80 | 58.00 | 148.85 |

Analysis-(b)

3 day Rainfall frequency analysis (Filling of Partial series data)

No. of years of record ‘N’ = (1974-1958) = 17

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Total peak rainfall MM(Y) | M |  T=N M | X=LogT-10 | XY | X2 |
| 1963 | 202.81 | 1 | 17.0 | 1.2304 | 250.00 | 1.4400 |
| 1960 | 193.00 | 2 | 8.50 | 0.9294 | 179.50 | 0.8649 |
| 1958 | 186.30 | 3 | 5.66 | 0.7528 | 140.00 | 0.5625 |
| 1964 | 173.60 | 4 | 4.25 | 0.6294 | 10.9.30 | 0.3969 |
| 1961 | 167.78 | 5 | 3.40 | 0.5315 | 88.80 | 0.2809 |
| 1971 | 151.27 | 6 | 2.83 | 0.4518 | 68.00 | 0.2025 |
| 1972 | 150.27 | 7 | 2.42 | 0.3838 | 57.00 | 0.1444 |
| 1967 | 150.10 | 8 | 2.12 | 0.3263 | 49.50 | 0.1089 |
| 1974 | 148.85 | 9 | 1.88 | 0.2742 | 40.20 | 0.729 |
| 1968 | 133.18 | 10 | 1.70 | 0.2304 | 30.65 | 0.0529 |
| 1969 | 127.57 | 11 | 1.54 | 0.1875 | 24.25 | 0.0324 |
| 1966 | 111.75 | 12 | 1.41 | 0.1461 | 16.75 | 0.0213 |
| 1965 | 106.08 | 13 | 1.30 | 0.1139 | 11.70 | 0.121 |
| 1970 | 103.28 | 14 | 1.21 | 0.828 | 8.27 | 0.0068 |
| 1973 | 100.50 | 15 | 1.13 | 0.0531 | 5.25 | 0.0028 |
| 1962 | 99.00 | 16 | 1.06 | 0.0253 | 2.97 | 00.62 |
| 1959 | 66.94 | 17 | 1.00 | 0.000 | 0.00 | 00.00 |
| Total 2272.27 6.3487 1082.14 4.2084 |

 Analysis – I(c)

 Shahdara Block (3 day rainfall analysis).

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Y = EY = 2272.27 = 133.80

 N 17

\_

X = EX = 0.3734

 N

 X2 = 0.137

 B = EXY- NXY

 EX2-NX2 = 1082.14-17(0.3734X133.80)

 4.2084- 17X0.137

 = 132

A = \_

 Y - BX

= 133.80 – 132 x 0.3734

= 133.80-49.36

= 84.44

Line of best fit Y = A+B Log 10 T

= 84.44 +132 Log 10 5/

= 176.54 mm.

3 day max. in rainfall for a return period of 5 years.

 = 176.54 mm

 = 6.95”

10.0 Design criteria (Shahdara basin drain)

 10.1 Arterial drains

 (Drain No.I, Drain No.II, Gokulpur Drain, Ghazipur Drain, Shahdara drain, Khichripur drain, Outfall drain).

Urban catchment.

Design discharge from urban catchment has been calculated by the rational method on the basis of 5 years rainfall frequency, 0.45 runoff co-efficient and 80% dispersion factor.

Rural catchment.

Design discharge has been calculated on the basis of 10 cusecs/sq. miles corresponding to a 3 day rainfall intensity of 6.95” of 5 years frequency.

10.2 All other drains.

 Design discharge has been calculated on the basis of 0.5 cusecs per acre of urban catchment and 1 cusecs/sq. miles rural catchment.

10.3 Rugosity co-efficient.

 Drains have been designed using Manning’s Formula. Value of rugosity co-efficient N in the formula has been adopted as given below:-

Unlined = N = 0.025

Masonry lining = N = 0.018 to 0.020

Brick and cement

Concrete walls = N = 0.015 to 0018

With plaster

10.4 Design velocity

Drains have been designed with the following limits of velocity. 0.6 M/Sec to 1.5 M/Sec for unlined sections and 3 M/Sec for lined section.

10.5 Waterway at bridge/culverts

 Waterway at bridges/culverts has been provided, to cater for ultimate discharge with negligible head loss at the structure. Flight variation from the above has been allowed to retain the existing section of the structures wherever necessary.

Afflux at upstream of bridges/culverts has been permitted according to the norms discussed in chapter-I.

10.6 Vertical clearance

Minimum vertical clearance to the bridge/culverts has been provided as below:-

 Discharge Vertical clearance

 Upto 0.3 M3/Sec 150 mm

 Above 0.3 M3/Sec

 Upto 3.0 m/Sec 450 mm

 Above 3.0 m3/Sec

 Upto 30 m3/Sec 600 mm

 Above 30 m3/sec 900 mm

 10.7 Free Board

Minimum free board to the drain has been provided as below:-

 Discharges upto 150 m3/Sec. 0.5 metre

 Above 150 m3/Sec. 1 metre.

 10.8 Side slopes have been kept as per norms discussed in Chapter-I.