DETENTION CALCULATIONS

DRAINAGE DESIGN METHODOLOGY

RUNOFF FROM PROPERTY WILL BE COLLECTED AND OUTFALL INTO EXISTING 18" RCP STORM DRAIN IN QUORUM DRIVE. ON-SITE DETENTION WILL BE USED TO RESTRICT THE OUTFALL INTO THE EXISTING 18" RCP SO AS NOT TO EXCEED THE CAPACITY OF THE EXISTING STORM DRAIN SYSTEM.

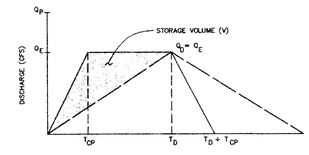
THE EXISTING 18" RCP STORM DRAIN WAS CONSTRUCTED ON 2.1% GRADE WHICH RESULTS IN A CAPACITY OF 15.2 CFS.

AREAS B1 AND B2 BYPASS THE DETENTION SYSTEM AND FLOW INTO THE EXISTING CURB INLETS IN QUORUM DRIVE. THE RUNOFF FROM AREAS B1 AND B2 IS 9.0 CFS.

THUS, THE MAXIMUM FLOWRATE FROM THE DETENTION SYSTEM INTO THE EXSITING 18" RCP EQUALS 15.3 CFS - 9.0 CFS = 6.3 CFS.

THE TOTAL POST-DEVELOPMENT RUNOFF FROM THE SITE INTO THE DETENTION BASINS (AREAS A1 THRU A10) EQUALS 24.7 CFS. THE RESTRICTED OUTFALL OF 6.3 REQUIRES DETENTION OF THE DIFFERENCE (74.5% RESTRICTION OR OUTFALL RESTRICTED OT 25.5% OF TOTAL FLOW)

DETENTION CALCULATION METHODOLOGY



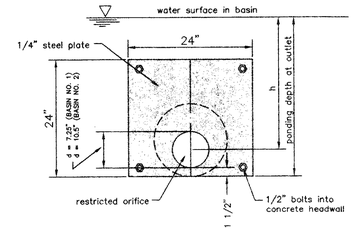
$$V = \left(\frac{60}{43560}\right)\left[\left(Q_D\left[T_D - T_{CP}\right) + \left(T_D + T_{CP}\right)\right]/2\right) - \left(Q_E\left[T_{CP} + T_D\right]/2\right]$$

in acre - feet:

Where:
- Q_P = Peak discharge in cfs for developed watershed using storm duration equal to T_{CP}
- Q_E = Peak discharge in cfs for existing watershed, assuming full residential development and corresponding T_C
- Q_D = Peak discharge in cfs for developed watershed based on a storm duration that yeilds the existing discharge for C_P and A:
- T_{CP} = Time of concentration in minutes for proposed development.
- T_D = Storm duration in minutes corresponding to I_D
- I_D = Rainfall intensity (inches/hour) for a storm duration that produces Q_D and is calculated using the following formula:

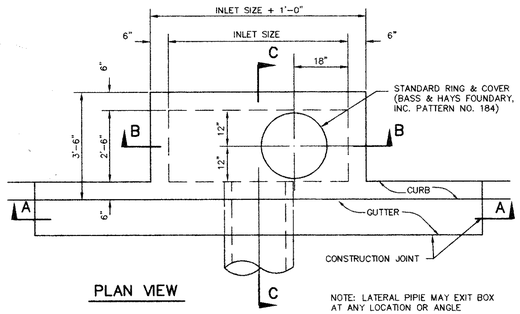
$$I = \frac{Q_D}{(C_P\ A)}$$

Where:
- C_P = Rational "C" for developed condition.
- A = Drainage area in acres.



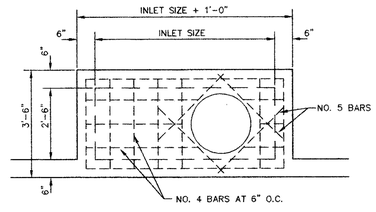
STEEL RESTRICTOR PLATE (ORIFICE) DETAIL

NOT TO SCALE

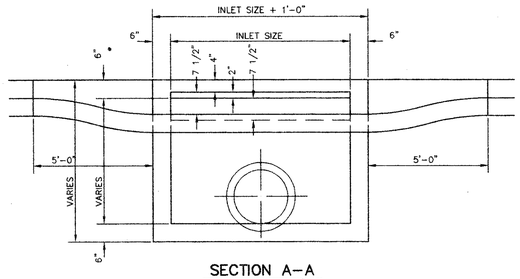


PLAN VIEW

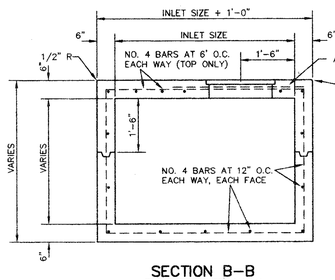
NOTE: LATERAL PIPIE MAY EXIT BOX AT ANY LOCATION OR ANGLE



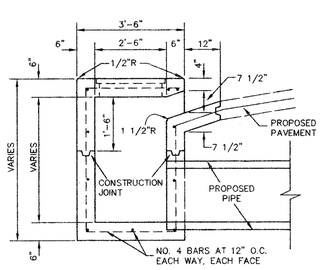
TOP REINFORCING PLAN



SECTION A-A



SECTION B-B



SECTION C-C

CURB INLET DETAILS

NOT TO SCALE

DETENTION BASIN NO. 1 (UPPER DETENTION BASIN)

REQUIRED DETENTION VOLUME CALCULATIONS

Contributing drainage areas = A1 thru A6 = 1.37 acres
Q_P = 1.37(0.95)10.0 = 13.02 cfs
Restricted flow = 0.255(13.02) = 3.32 cfs

Thus $Q_E = Q_D$ = 3.32 cfs

$$I_D = \frac{Q_D}{(C_P\ A)} = 3.32/((0.95)(1.37)) = 2.55 \text{ in/hr}$$

for I_D = 2.55 in/hr T_D = 120 minutes

Thus, Detention Volume Required = 11,247 cubic feet

The average area of detention basin no. 1 = 2,890 square feet which results in an average depth of 11,247/2,890 = 3.89 feet

ORIFICE CALCULATION FOR OUTLET PIPE

$Q = CA\sqrt{2gh}$

Where
- Q = Flow through orfice in (cfs)
- C = Coefficent for orifice with tube outlet = 0.80
- A = Area of orifice opening in (ft^2)
- g = acceleration due to gravity = 32.2 ft/sec^2
- h = head or orifice in feet

Solve by trial and error

For average depth of 3.89 feet, Ponding Depth at outlet = 4.25 feet
For 6 1/2"" Diameter Outlet (Restrictor Plate)
A = 0.2304 ft^2

Thus $Q = 0.8(0.2304)\sqrt{2(32.2)(4.25-1.5/12-6.5/12/2)}$
Q = 3.19 cfs < 3.32 cfs allowed

DETENTION BASIN NO. 2 (LOWER DETENTION BASIN)

REQUIRED DETENTION VOLUME CALCULATIONS

Contributing drainage areas = A7 thru A10 = 1.19 acres
Q_P = 1.19(0.95)10.0 + Outflow from upper basin = 11.31 +3.32 = 14.63 cfs
Restricted flow = 6.3 cfs
For total flow of 14.63 cfs, equivalent area = 14.63/((0.95)(10.0)) = 1.54 acres

Thus $Q_E = Q_D$ = 6.30 cfs

$$I_D = \frac{Q_D}{(C_P\ A)} = 6.30/((0.95)(1.54)) = 4.31 \text{ in/hr}$$

for I_D = 4.31 in/hr T_D = 53 minutes

Thus, Detention Volume Required = 9,072 cubic feet

The average area of detention basin no. 2 = 3,048 square feet which results in an average dpth of 9,072/3,048 = 2.98 feet

ORIFICE CALCULATION FOR OUTLET PIPE

$Q = CA\sqrt{2gh}$

Where
- Q = Flow through orfice in (cfs)
- C = Coefficent for orifice with tube outlet = 0.80
- A = Area of orifice opening in (ft^2)
- g = acceleration due to gravity = 32.2 ft/sec^2
- h = head or orifice in feet

Solve by trial and error

For average depth of 3.00 feet, Ponding Depth at outlet = 3.45 feet
For 10 1/4"" Diameter Outlet (Restrictor Plate)
A = 0.5730 ft^2

Thus $Q = 0.8(0.5730)\sqrt{2(32.2)(3.45-1.5/12-10.25/12/2)}$
Q = 6.26 cfs < 6.3 cfs allowed

AS-BUILT

JDJR ENGINEERS AND CONSULTANTS
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Tel 972-255-1601 Fax 972-790-9470

STATE OF TEXAS
JAMES DEWEY, JR.
61480
REGISTERED PROFESSIONAL ENGINEER
7-29-97

PROJECT:
A NEW OFFICE BUILDING FOR
NATIONAL TEACHERS ASSOCIATION, INC.
KELLER SPRINGS ROAD AT QUORUM ROAD
ADDISON, TEXAS

REVISIONS:	
DATE	REVISION
6-16-97	CITY COMMENTS
7-29-97	REVISE DET. PONDS

SHEET TITLE
STORM DRAIN DETAILS AND DETENTION CALCULATIONS

DATE: MAY 16, 1997
SCALE: 1" = 30'
DRAWN BY: SAS (ACAD)
CHECKED BY: JDJ
SHEET NO.
C5 OF 8
JDJR FILE NO. 97-007

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