PROPOSED INSTITUTIONAL DEVELOPMENT SITE

TWO-STOREY BUILDING ADDITION

TO

EXISTING ONE-STOREY SCHOOL BUILDING

10 CORAL AVENUE

PART OF BLOCK A

(BEING PARTS 2, 3 & 4, PLAN 5R-11666) R-PLAN 310509

CITY OF OTTAWA

STORM DRAINAGE REPORT

REPORT No. R-813-35

T. L. MAK ENGINEERING CONSULTANTS LTD.

NOVEMBER 2013

FILE REF. No. 813-35

INTRODUCTION

The site under consideration for development is the existing one-storey school building located at 10 Coral Avenue. The total size of this institutional property is ± 1.256 hectares. It is situated immediately south of Coral Avenue, east of Sutton Place and west of Barlyn Avenue. The legal property description is Part of Block A (Being Parts 2, 3 & 4, Plan 5R-11666) R-Plan 310509 City of Ottawa.

The Ottawa Islamic School is proposing to expand the existing building floor space from 2,674.0 sq. m to a gross building area of 4,494.3 sq. m with a two-storey building addition consisting of a ground floor addition of 1,172.2 sq. m and a second floor addition of 648.1 sq. m. The expansion to the existing school is proposed along the west wall of the school towards Sutton Place.

The new two-storey building addition will accommodate a gymnasium and five classrooms. This new building will incorporate a flat rooftop that will be used for on-site stormwater management attenuation purposes.

Presently, the existing school building services are connected to the Barlyn Avenue municipal sewers. Stormwater drainage currently drains to Coral Avenue and Barlyn Avenue. The west portion of the site approximately ± 0.33 ha. proposed for the building addition is currently all grassed area and is surface drained to outlet to the existing Sutton Place 300 mm diameter storm sewer system. From discussions with the school's architect, the new roof drains and stormwater piping will not be connected to the existing school services.

Stormwater outlet for surface drainage and the new roof drains is the existing 300 mm diameter Sutton Place storm sewers.

For this proposed building addition development, the City of Ottawa requires that the allowable post-development runoff release rates shall not exceed the 5 year pre-development conditions. For this site, the pre-development existing runoff coefficient established is C = 0.25. If the post-development coefficient of runoff exceeds the pre-development value, then on-site stormwater management (SWM) control measures will be required.

This report will address and detail the grading, drainage and stormwater management control measures required to develop this property. The post-development runoff coefficient for the roof area of the proposed building addition is 0.9 which exceeds the City of Ottawa's allowable coefficient of runoff of C = 0.25 (grass area for pre-development conditions) without on-site stormwater management (SWM) control. Therefore SWM calculations and on-site detention design is required for this development site.

The SWM calculations that follow will detail the extent of on-site SWM control to be implemented and the storage volume required on-site to attain the appropriate runoff release that will conform to the City's established drainage criteria.

SITE DATA

- Area characteristics

Tributary Area (outletting to Sutton Place) = 3,300.0 sq. m
Roof Area = 1,172.4 sq. m
Grass Area = 2,127.6 sq. m

- Tributary areas (existing grass area) consisting of approximately 2,127.6 sq. m will be outletting off-site uncontrolled.

- The controlled SWM area (building rooftop) is therefore 0.11724 ha. in size. (See Figure 1 for details.)

MAXIMUM ALLOWABLE OFF-SITE FLOW RATE

A = 3,300.0 sq. m = 0.33 ha.
C = 0.25
T_c = 15 min.
I_5 = 83.6 mm/hr (City of Ottawa, 5 year storm)

Using the Rational Method

Q = 2.78 (0.25) (83.6) (0.33)
= 19.17 L/s

Therefore, for a 5 year storm event, the calculated maximum allowable off-site flow is estimated at 19.17 L/s for this part of the proposed development site.

Since 0.213 ha. is drained uncontrolled off-site, therefore accordingly the net allowable discharge for this site into the existing 300 mm diameter storm sewer is Q = [2.78 (0.25) (83.6) (0.330)] – [2.78 (0.25) (0.213) (120)] = 1.40 L/s.

Thus, the maximum allowable off-site flow of 1.40 L/s from (2) rooftop drains will be used to calculate and size the required on-site storage volume to attenuate the 5 year and 100 year storm event required by the City.

STORMWATER MANAGEMENT ANALYSIS

It is proposed that the flat rooftop of the proposed building addition will incorporate (2) controlled roof drains to provide on-site stormwater detention. Within the west portion of the existing site that outlets to Sutton Place, the existing grass area will remain as grass area only and a building footprint area of 1,172.4 m^2 is proposed for development.

The building rooftop tributary area = 0.11724 ha.

Because the new flat rooftop of the building addition is proposed for this property to attenuate stormwater flow, it will incorporate (2) roof drains to control stormwater release from the rooftop in discharging stormwater into the existing 300 mm diameter Sutton Place storm sewer. Therefore the stormwater flow that can be controlled from this rooftop with (2) roof drains is 1.40 L/s.

Roof Area = 1,172.4 sq. m

DESIGN DISCHARGE COMPUTATION

The Rational Method was used to estimate peak flows.

$Q = 2.78\ CIA$

Coefficient of runoff is C = 0.9 for rooftop surfaces.

To Calculate Roof Storage

C = 0.9 will be used for sizing roof storage volume in this case.

Inflow rate (Q_A) = 2.78 CIA

where C = 0.9
A = Surface area of roof
I = (mm/hr)

The inflow rate or Q_{ACTUAL} during the 5 and 100 year storm for each of the 2 sub-tributary areas of this site can be calculated as follows:

For Tributary Area No. 1 (Roof Area #1)

5 Year Event

$Q_{A1} = 2.78\ CIA_1$

C = 0.90
A = 586.2 sq. m
I = (mm/hr)

= 2.78 (0.9) (0.0586 ha.) I
= 0.1467 I

100 Year Event

Q_{A1} = 2.78 (1.0) (0.0586 ha.) I
= 0.163 I

For Tributary Area No. 2 (Roof Area #2)

5 Year Event

$Q_{A2} = 2.78\ CIA_2$

C = 0.90
A = 586.2 sq. m
I = (mm/hr)

= 2.78 (0.9) (0.0586 ha.) I
= 0.1467 I

100 Year Event

Q_{A2} = 2.78 (1.0) (0.0586 ha.) I
= 0.163 I

The allowable discharge for Roof Area #1
- 1 roof drain @ release rate of $\frac{1.40\ L/s}{2}$ = 0.70 L/s.

The allowable discharge for Roof Area #2
- 1 roof drain @ release rate of $\frac{1.40\ L/s}{2}$ = 0.70 L/s.

This can now be used to determine the storage volume for the site using the Modified Rational Method.

- Actual flow Q_{ACTUAL} is calculated as:
  $Q_{A(i)} = 2.78\ CIA_{(i)}$

- Q_{STORED} is calculated as:
  $Q_{S(i)} = Q_{A(i)} - Q_{ALLOW}$

Summary results of the calculated inflow and the required storage volume of the (2) roof areas on this site to store the 5 year and 100 year storm events are shown in Tables 1 to 4 inclusive.

CONCLUSION

Because of the new two-storey building addition to the existing one-storey school building at 10 Coral Avenue, the City of Ottawa will require on-site stormwater management control from this new building to its pre-development condition.

For development of the said institutional property that will entail a two-storey building addition and in order to control the allowable stormwater release rate off-site to a flow rate of 1.40 L/s, (2) roof drains each at 0.70 L/s are proposed to control and attenuate flow at the flat rooftop of the new building at Roof Area #1 and Roof Area #2. Refer to Dwg. No. 813-35, G-1 for details.

During the 5 year storm event for Roof Area #1, the ponding depth on this rooftop is estimated at 130 mm at the drain and 0 mm at the roof perimeter assuming a roof pitch range of 0.83% to 1.6% to the drain. The rooftop storage available is 19.02 m^3 which is greater than the required volume of 15.54 m^3.

For Roof Area #2, the ponding depth on this rooftop is estimated at 130 mm at the drain and 0 mm at the roof perimeter assuming a roof pitch range of 0.83% to 1.6% to the drain. The rooftop storage available is 19.02 m^3 which is greater than the required volume of 15.54 m^3.

During the 100 year storm event for Roof Area #1, the ponding depth on this rooftop is estimated at 160 mm at the drain and 10 mm at the roof perimeter assuming a roof pitch range of 0.83% to 1.6% to the drain. The rooftop storage available is 34.80 m^3 which is greater than the required volume of 34.59 m^3.

For Roof Area #2, the ponding depth on this rooftop is estimated at 160 mm at the drain and 10 mm at the roof perimeter assuming a roof pitch range of 0.83% to 1.6% to the drain. The rooftop storage available is 34.80 m^3 which is greater than the required volume of 34.59 m^3.

Refer to Appendix A for the 5 year and 100 year available storage volume calculations. It should be noted that at the roof perimeter of both Roof Area #1 and #2, emergency overflow scuppers are proposed at 25 mm or 1 inch above the perimeter roof surface in case of debris blockage at the drains. Refer to Dwg. No. 813-35, G-1 for details of scupper locations and typical control roof drain.

Therefore by installing two roof drains each having a release rate of 0.70 L/s or 11.1 U.S. gal/min. at the location as depicted on (Dwg. No. 813-35, G-1), the total 5 year and 100 year flow from the rooftop of the new building is restricted to 1.40 L/s.

PREPARED BY T. L. MAK ENGINEERING CONSULTANTS LTD.

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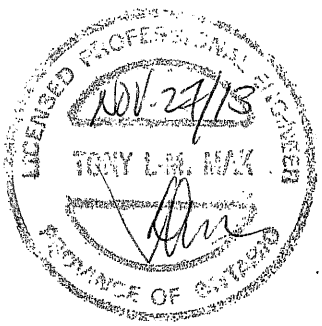


TABLE 1

5 YEAR EVENT

REQUIRED BUILDING ROOF AREA #1
STORAGE VOLUME TABLE

t_c (min.)	I 5 YR. (mm/hr)	Q ACTUAL (L/s)	Q ALLOW (L/s)	Q STORED (L/s)	VOLUME STORED (m^3)
5	141.2	20.71	0.70	20.01	6.00
10	104.2	15.29	0.70	14.59	8.75
15	83.5	12.25	0.70	11.55	10.40
20	70.25	10.31	0.70	9.61	11.53
25	60.90	8.93	0.70	8.23	12.35
30	53.93	7.91	0.70	7.21	12.98
40	44.19	6.48	0.70	5.78	13.87
50	37.65	5.52	0.70	4.82	14.46
60	32.94	4.83	0.70	4.13	14.87
70	29.37	4.31	0.70	3.61	15.16
80	26.56	3.90	0.70	3.20	15.36
90	24.29	3.56	0.70	2.86	15.44
100	22.41	3.29	0.70	2.59	15.54
110	20.82	3.05	0.70	2.35	15.51

Therefore the required storage volume is 15.54 m^3.

TABLE 2

5 YEAR EVENT

REQUIRED BUILDING ROOF AREA #2
STORAGE VOLUME TABLE

t_c (min.)	I 5 YR. (mm/hr)	Q ACTUAL (L/s)	Q ALLOW (L/s)	Q STORED (L/s)	VOLUME STORED (m^3)
5	141.2	20.71	0.70	20.01	6.00
10	104.2	15.29	0.70	14.59	8.75
15	83.5	12.25	0.70	11.55	10.40
20	70.25	10.31	0.70	9.61	11.53
25	60.90	8.93	0.70	8.23	12.35
30	53.93	7.91	0.70	7.21	12.98
40	44.19	6.48	0.70	5.78	13.87
50	37.65	5.52	0.70	4.82	14.46
60	32.94	4.83	0.70	4.13	14.87
70	29.37	4.31	0.70	3.61	15.16
80	26.56	3.90	0.70	3.20	15.36
90	24.29	3.56	0.70	2.86	15.44
100	22.41	3.29	0.70	2.59	15.54
110	20.82	3.05	0.70	2.35	15.51

Therefore the required storage volume is 15.54 m^3.

TABLE 3

100 YEAR EVENT

REQUIRED BUILDING ROOF AREA #1
STORAGE VOLUME TABLE

t_c (min.)	I 100 YR. (mm/hr)	Q ACTUAL (L/s)	Q ALLOW (L/s)	Q STORED (L/s)	VOLUME STORED (m^3)
10	178.6	29.11	0.70	28.41	17.05
15	142.9	23.29	0.70	22.59	20.33
20	120.0	19.56	0.70	18.86	22.63
25	103.8	16.92	0.70	16.22	24.33
30	91.9	14.98	0.70	14.28	25.70
35	82.6	13.46	0.70	12.76	26.80
40	75.1	12.24	0.70	11.54	27.70
45	69.1	11.26	0.70	10.56	28.51
50	63.9	10.42	0.70	9.72	29.16
60	55.9	9.11	0.70	8.41	30.28
70	49.79	8.12	0.70	7.42	31.16
80	44.99	7.33	0.70	6.63	31.82
90	41.11	6.70	0.70	6.00	32.40
100	37.90	6.18	0.70	5.48	32.88
110	35.20	5.74	0.70	5.04	33.26
120	32.90	5.36	0.70	4.66	33.55
130	30.90	5.04	0.70	4.34	33.85
140	29.15	4.75	0.70	4.05	34.02
150	27.61	4.50	0.70	3.80	34.20
160	26.24	4.28	0.70	3.58	34.37
165	25.61	4.17	0.70	3.47	34.35
170	25.01	4.08	0.70	3.38	34.48
180	23.90	3.90	0.70	3.20	34.56
190	22.90	3.733	0.70	3.033	34.58
195	22.43	3.656	0.70	2.956	34.59
200	21.98	3.58	0.70	2.88	34.56

Therefore the required storage volume is 34.59 m^3.

TABLE 4

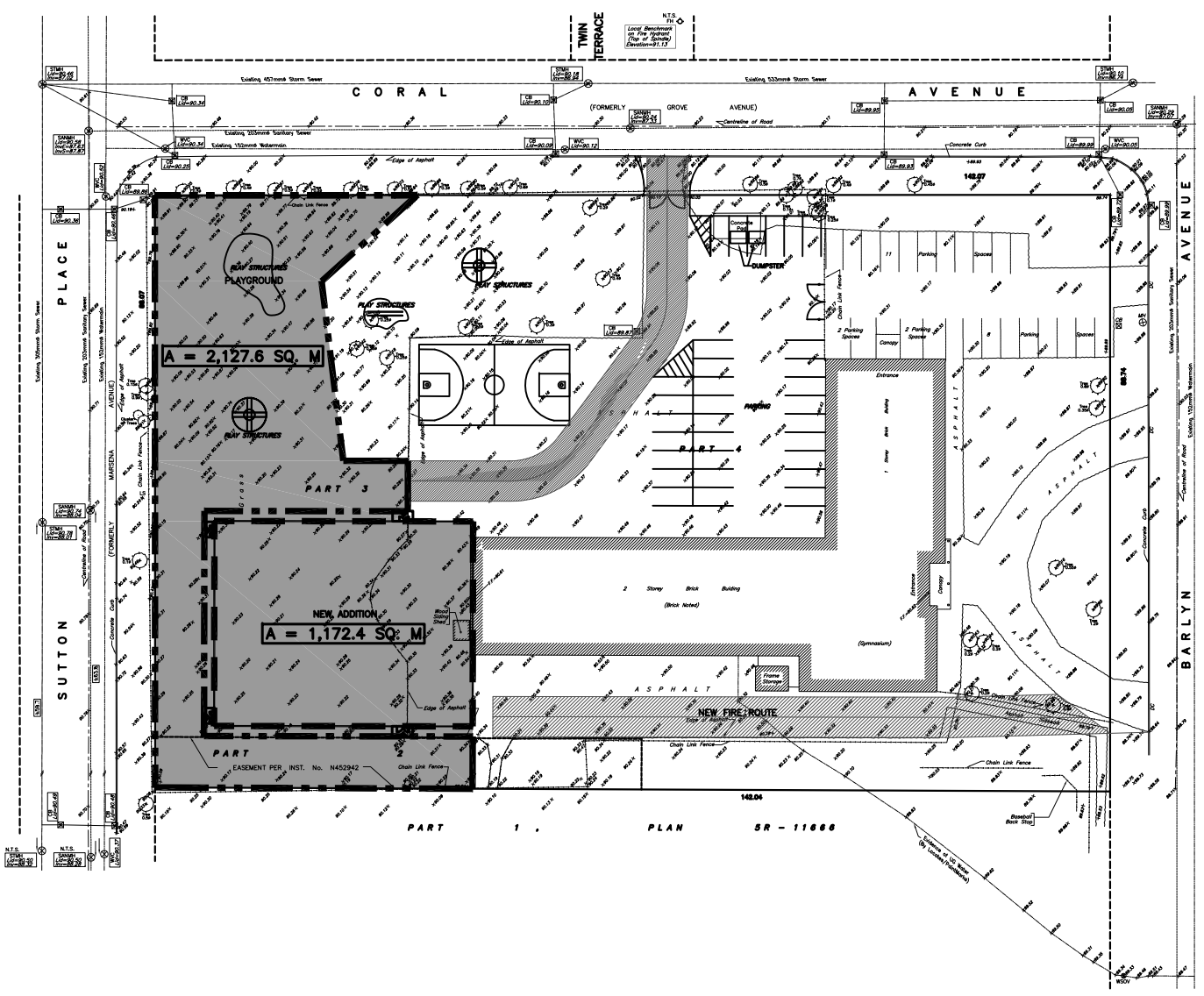
100 YEAR EVENT

REQUIRED BUILDING ROOF AREA #2
STORAGE VOLUME TABLE

t_c (min.)	I 100 YR. (mm/hr)	Q ACTUAL (L/s)	Q ALLOW (L/s)	Q STORED (L/s)	VOLUME STORED (m^3)
10	178.6	29.11	0.70	28.41	17.05
15	142.9	23.29	0.70	22.59	20.33
20	120.0	19.56	0.70	18.86	22.63
25	103.8	16.92	0.70	16.22	24.33
30	91.9	14.98	0.70	14.28	25.70
35	82.6	13.46	0.70	12.76	26.80
40	75.1	12.24	0.70	11.54	27.70
45	69.1	11.26	0.70	10.56	28.51
50	63.9	10.42	0.70	9.72	29.16
60	55.9	9.11	0.70	8.41	30.28
70	49.79	8.12	0.70	7.42	31.16
80	44.99	7.33	0.70	6.63	31.82
90	41.11	6.70	0.70	6.00	32.40
100	37.90	6.18	0.70	5.48	32.88
110	35.20	5.74	0.70	5.04	33.26
120	32.90	5.36	0.70	4.66	33.55
130	30.90	5.04	0.70	4.34	33.85
140	29.15	4.75	0.70	4.05	34.02
150	27.61	4.50	0.70	3.80	34.20
160	26.24	4.28	0.70	3.58	34.37
165	25.61	4.17	0.70	3.47	34.35
170	25.01	4.08	0.70	3.38	34.48
180	23.90	3.90	0.70	3.20	34.56
190	22.90	3.733	0.70	3.033	34.58
195	22.43	3.656	0.70	2.956	34.59
200	21.98	3.58	0.70	2.88	34.56

Therefore the required storage volume is 34.59 m^3.

PROPOSED 10 CORAL AVENUE
SITE DEVELOPMENT
DRAINAGE AREA PLAN
NOT TO SCALE



LEGEND

- LIMIT OF CONTROLLED STORM DRAINAGE AREA = 1,172.4 SQ. M
- LIMIT OF UNCONTROLLED STORM DRAINAGE AREA = 2,127.6 SQ. M
- WEST PORTION OF SCHOOL AREA DRAINING TO SUTTON PLACE A = 0.33 HA.

FIGURE 1

PROPOSED INSTITUTIONAL DEVELOPMENT SITE

TWO-STOREY BUILDING ADDITION

TO

EXISTING ONE-STOREY SCHOOL BUILDING

10 CORAL AVENUE

PART OF BLOCK A

(BEING PARTS 2, 3 & 4, PLAN 5R-11666) R-PLAN 310509

CITY OF OTTAWA

APPENDIX A

DETAILED CALCULATIONS FOR

THE 5 YEAR AND 100 YEAR

AVAILABLE STORAGE VOLUME

ROOFTOP STORAGE

Roof Area #1 and #2 will be used for stormwater detention. Each area will be drained by a controlled drain designed for a release rate of 11.1 U.S. gal/min. or 0.70 L/s.

A.) 5 Year Event

1.) Roof Storage Area No. 1

- Available flat roof area for storage = 586.2 m^2 @ roof slope range of 0.83% to 1.6% therefore the available roof area will store a volume as shown below using the reservoir volume equation.

$$= \frac{0.13 \text{ m } (438.24 + 4\ (109.88) + 0)}{6} \qquad = \frac{(0.13)\ (877.76)}{6}$$

$$= \underline{19.02 \text{ m}^3}$$

which provides an available storage volume of 19.02 m^3 > required 5 year storage volume of 15.54 m^3 from Table 1.

Therefore ponding depth at the drain location is approximately 0.13 m (130 mm) and the 5 year level is estimated not to reach the roof perimeter of the building.

2.) Roof Storage Area No. 2

- Available flat roof area for storage = 586.2 m^2 @ roof slope range of 0.83% to 1.6% the roof pitched area will store a volume of:

$$= \frac{0.13 \text{ m } (438.24 + 4\ (109.88) + 0)}{6} \qquad = \frac{(0.13)\ (877.76)}{6}$$

$$= \underline{19.02 \text{ m}^3}$$

which provides an available storage volume of 19.02 m^3 > required 5 year storage volume of 15.54 m^3 from Table 2.

Therefore ponding depth at the drain location is approximately 0.13 m (130 mm) and the 5 year level is estimated not to reach the roof perimeter of the building.

B.) 100 Year Event

1.) Roof Storage Area No. 1

- Available flat roof area for storage = 586.2 m^2 @ roof slope range of 0.83% to 1.6% therefore the available roof area will store a volume as shown below using the reservoir volume equation.

$$= \frac{0.15 \text{ m } (586.2 + 4\ (142.88) + 0)}{6} + (586.2 \times 0.01) \qquad = \frac{(0.15)\ (1{,}157.72)}{6} + 5.86$$

$$= 28.94 + 5.86$$

$$= \underline{34.80 \text{ m}^3}$$

The available storage volume of Roof Area #1 is 34.80 m^3 > required 100 year storage volume of 34.59 m^3 from Table 3.

Therefore ponding depth at the proposed Drain #1 location is approximately 0.16 m (160 mm) and at the perimeter of Roof Area #1 is 0 mm above the roof surface. It is recommended that roof scuppers be installed at 0.025 m or 1 inch above the perimeter height of the rooftop for emergency overflow purposes in case of blockage from debris build up at the roof drain. Refer to Dwg. No. 813-35, G-1 for details.

2.) Roof Storage Area No. 2

- Available flat roof area for storage = 586.2 m^2 @ roof slope range of 0.83% to 1.6% the available roof area will store a volume as shown below using the reservoir volume equation.

$$= \frac{0.15 \text{ m } (586.2 + 4\ (142.88) + 0)}{6} + (586.2 \times 0.01) \qquad = \frac{(0.15)\ (1{,}157.72)}{6} + 5.86$$

$$= 28.94 + 5.86$$

$$= \underline{34.80 \text{ m}^3}$$

which provides an available storage volume of 34.80 m^3 > required 100 year storage volume of 34.59 m^3 from Table 4.

Therefore ponding depth at the proposed Drain #2 location is approximately 0.16 m (160 mm) and at the perimeter of Roof Area #2 is 0 mm above the roof surface. It is recommended that roof scuppers be installed at 0.025 m or 1 inch above the perimeter height of the rooftop for emergency overflow purposes in case of blockage from debris build up at the roof drain. Refer to Dwg No. 813-35, G-1 for details.