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September 20, 2017

Mr. Jerry Hancock
Stormwater and Floodplain Programs Coordinator
City of Ann Arbor
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Sent via E-mail: JHancock@a2gov.org

RE: Stormwater Detention Basin Design
1140 Broadway Street
Ann Arbor, Michigan
SME Project No. 073987.03

Greetings Mr. Hancock

This letter addresses the design of the stormwater detention basin to be constructed below Building A2 – Parking Structure of 1140 Broadway Street, as shown in Figure 1 below.

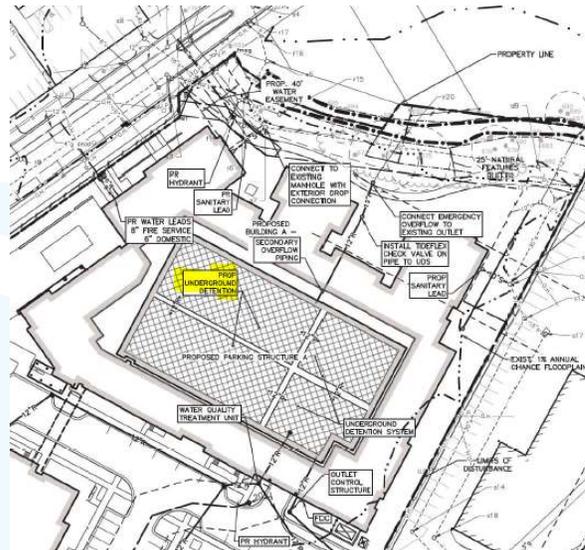


Figure 1: Stormwater Detention Basin

As required by the Michigan Building Code all structures are required to be designed for anticipated loadings according to ASCE 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. This included loads which may occur during extreme events such as during flooding. In addition, although the stormwater detention basin is not a basement in the traditional sense, it does meet the broad definition of a “basement” under the FEMA’s Technical Bulletin 10-01 *Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas are Reasonably Safe From Flooding* (FEMA TB 10-1).

FEMA TB 10-1 does allow basements to be constructed below the Base Flood Elevation (BFE) as defined by the 100-year flood elevation and still be considered “Reasonably Safe From Flooding”, provided two basic requirements must be met; first the structure has to be “dry”, and second it has to be structurally sound during a flood. These requirements are necessary for the project regardless of FEMA TB 10-1.

The stormwater detention basin will be constructed of reinforced cast-in-place concrete with a concrete mat foundation over the entire base, concrete walls on the sides, and a precast concrete deck on top. Essentially, it will be a large underground concrete basin to temporarily store stormwater collected from the surface during storm events. The stormwater then gradually flows out of the basin into the public stormwater water system. The basin will be laterally separated from the floodplain by 30 feet.

Since the detention basin’s purpose will be to store stormwater it will never be “dry” in the same way a conventional basement for a house needs to be dry. However, to prevent groundwater from entering the basin, the bottom and sides of the basin will be waterproofed. The waterproofing will provide a uniform and consistent barrier to any water flow into the basin, meeting the first requirement of FEMA TB 10-1.

FEMA TB 10-1’s second requirement is that the basin needs to be structurally sound during a 100 year flood event. This means designing the basin for anticipated hydrostatic pressures caused by the rise in flood waters. Practically, this is necessary for basic engineering practice and to meet the building codes, regardless of the FEMA requirement.

During a flood, the soils around the basin can be saturated with water as the groundwater levels rise in response to the rising water levels in the flood plain (see Figure 2). Depending on the dynamics of the flood event, there could be a lag between the rise in the water level in the basin and the groundwater level outside the basin. This lag can create an unbalanced hydrostatic condition on the walls and base mat slab of the basin structure. The lateral pressures on the walls increase as the groundwater levels rise due to the unbalanced water pressures and an upward water pressure (uplift) is created under the mat foundation.

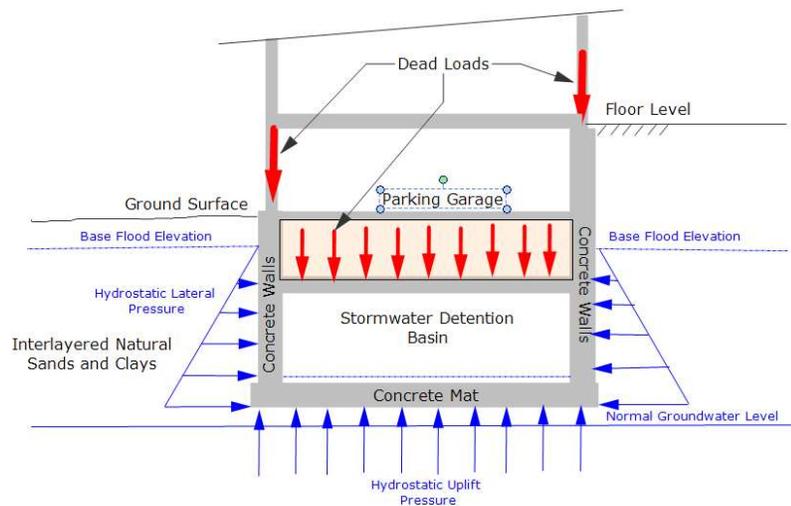


Figure 2: Detention Basin - Flood Conditions

The weight (i.e., dead loads) of the basin and the overlying parking structure are more than enough to offset uplift forces from excess water pressure and to prevent the basin from lifting out of the ground. In addition, as required by the Michigan Building Code, the hydrostatic pressure due to the 100 year flood event will be included as one of the various design load cases for the structural design of the reinforced

concrete walls and base mat for the detention basin. Therefore, the reinforced concrete basin will be structurally sound under all loading conditons, include the extreme flooding event.

In summary, both requirements of FEMA TB 10-1 will be met for the detention basin to be deemed "*Reasonably Safe from Flooding*".

If you have questions concerning this letter, please contact me.

Sincerely,

SME

Timothy H. Bedenis, PE
Vice President/Chief Geotechnical Engineer

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