Floodproofing Certification Review
The City of Key West (Monroe County), Florida

We reviewed two floodproofing certifications:

1. "Floodproofing Checklist and Associated Materials for [redacted]., Key West, FL 33040) prepared for [redacted] dated 5 November 2014). This is an entire package that includes calculations. There were no problems in reading these documents as they are very clear. This is a bound project report consisting of drawings, pictures, maps, and good context, which is over 100 pages. The pages are not numbered and it is difficult to identify the pages without counting them from the beginning.
2. [redacted] This report included flood load calculations for dry floodproofing measures for buildings 25 and 26 located at [redacted] Key West, FL 33040. These documents are hard to read all of the given details. There are 11 pages in total, of which 4 are purely Exhibit covers. There are no drawings, pictures, maps, and no overall project context.

The comments provided below may not be all inclusive because of lack of required design calculations and details:

<u>Regarding both</u>:
ASCE 24-05 requires debris impact loads, hydrostatic, and hydrodynamic loads (velocity) to be considered, as well as effects of scour and erosion, when appropriate, for flood loads, in addition to buoyant loads. Many of these loads were not addressed in either project. The reasons for not addressing them were not explained nor the assumptions stated for not addressing the various load calculations with adequate support.

[redacted]., <u>Key West, FL 33040</u>:

1) Calculations include buoyancy load and hydrostatic load on the CMU wall (for normal flood load but not for transfer load from flood plank) but we do not see any assumptions, or calculation of whether debris-impact loads or hydrodynamic loads (velocity), scour or erosion were even considered in the design. We recommend that the engineer/architect-of-record provide assumptions, to include whether these loads and situations were considered, and if not, explain the reasons as to why not, along with calculations when appropriate. In ASCE 24, Coastal A zones are those having wave heights of up to 1.5 feet above the stillwater elevation (in relation to the post storm eroded ground elevation), regardless of whether they are mapped as Coastal A zones. See section 4, among others, in ASCE 24-05.

2) The specifications for the PS Doors, Section 08390 Watertight doors states the following:
   "DESIGN / PERFORMANCE REQUIREMENTS

   A. Design watertight planks to perform under hydrostatic loads (and hydrodynamic or other loads as specified) to control short-term load

pressures indicated. All water pressure loads and operating loads are transferred to the building structure.

B. Standard loading: Standard Flood Planks are designed for hydrostatic loading, and have no additional allowances included for hydrodynamic loads, wave loads or debris impact loads."

A letter signed and sealed by [redacted], dated 26 September 2014 regarding Engineer Flood-proofing Certification Letter for non-residential building located at [redacted] states, " The structure up to the Design Flood Elevation of 9'-0" is resistant to hydrostatic, hydrodynamic and debris impact forces, including the effect of buoyancy."

However, we have not seen any assumptions stating there would be no debris impact loads or hydrodynamic loads, scour or erosion at the site, nor the load calculations, if they were considered.

3) The PS Doors Flood Plank Barrier Installation Instructions and Operators Manual states (on page 3), "These Type 2 Flood Closures/Barriers shall form essentially dry barriers or seals, allowing only slight seepage during the hydrostatic pressure conditions of flooding to the Regulatory Flood Datum (RFD) or the Design Flood Elevation (DFE). Seepage amounts will vary with conditions encountered. This issue should be addressed by the design professional and usage of sump or bilge type pumps should be used to offset potential water build-up."

We have not seen where a sump pump is provided for water infiltration. No dry flood-proofing system is completely "water tight" but the requirement is for "substantially impermeable". Technical Bulletin 3, Non-Residential Floodproofing (1993), states (on page 6):

"The building's walls must be "substantially impermeable to the passage of water." FEMA has adopted the U.S. Army Corps of Engineers (USACE) definition of substantially impermeable from the COE publication "Flood Proofing Regulations." This document states that a substantially impermeable wall "shall not permit the accumulation of more than 4 inches of water depth during a 24-hour period if there were no devices provided for its removal. However, sump pumps shall be required to control this seepage." Flood resistant materials, described in Technical Bulletin 2, "Flood-Resistant Materials Requirements," must be used in all areas where such seepage is likely to occur."

FEMA 936, Flood-proofing Non-Residential Buildings (July 2013), also states (on pages 1-3):

"**Substantially impermeable.** According to the U.S. Army Corps of Engineers (USACE), a wall is considered substantially impermeable if it limits water accumulation to 4 inches in a 24-hour period. In addition, sump pumps are required to control any

seepage and flood-resistant materials must be used in all areas where seepage is likely to occur. This standard is the minimum requirement; lower seepage rates are possible and strongly encouraged by FEMA, particularly in new construction (USACE 1995)."

FEMA used these criteria in developing the FEMA Technical Bulletin referenced above, in helping to define the minimum dry floodproofing requirements to meet the NFIP. Sump pumps are required to capture and address infiltration when dry floodproofing measures are used to meet the NFIP for flood insurance and floodplain management regulatory requirements. FEMA 936 also has a wealth of information on sump pump systems, calculations and planning, to help with design.

Section 6.2 of ASCE 24-05 states, "Sump pumps shall be provided to remove water accumulated due to any passage of vapor and seepage of water during the flooding event. Sump pumps shall not be relied upon as a means of dry floodproofing."

4) We have not seen any calculations demonstrating that the expected loads on the Flood Plank system would be adequately carried by the structure itself. Specifications state, "Mounting/Load Transfer: Anchor to existing structure. Flood Plank designed for specified hydrostatic pressure (and other loads as specified) and will transfer loads to adjacent structure."

   The PS Doors Flood Plank Barrier Installation Instructions and Operators Manual also states on page 3, "All water pressure loads, impact loads, and operating loads are transferred to the building structure. Building structure design, capacity to accept loads from flood barriers, and evaluation of loads to structure is by others."

   We have not seen any wall calculations provided, which demonstrate the existing structure is able to withstand the loads associated with the flood plank system transferring its flood loads to the walls.

   Regarding the Retail Buildings #25 and #26 project, only building #25 had an elevation certificate and was referenced in the engineer's letter by address (no building number), dated 5 March 2014. Therefore, these comments only address building #25; not building #26.

5) There are calculations for determining only the buoyant loads. The calculations for the hydrostatic, hydrodynamic, and debris-impact loads were not included. Also the effects of erosion and scour were not considered. The analyses also failed to include any assumptions, with appropriate justification, made for not considering these aspects of floodproofing certification. We recommend that the engineer/architect- of-record provide assumptions, to include whether these loads and situations were considered, and if not, explain the reasons as to why not, along with load calculations, as appropriate.

Structure located at [redacted] Key West, FL 33040

1) The Floodproofing Certificate indicates that the floodproofing height is 3.4 feet. This might be able to support a wave height of 1.5 feet, consistent with a Coastal A-zone, even if it is not mapped as a coastal A-zone. Coastal A-zones were not mapped back in 2005, when the FIS and FIRM became effective for this project site. However, the engineer is responsible for considering these effects in accordance with ASCE 24-05.

2) Only calculations were provided for this project, no design drawings, maps or other supporting documentation providing context. Therefore, we are unable to verify whether the assumptions made in the calculations are appropriate. For instance, it is entirely unclear how the floor slab is designed, to include any thickened grade beams or slabs, along with its reinforcement. Without having these details, it's unclear whether the slab could fail locally or through uplift bending due to buoyant forces. This has occurred in the past as has been seen through post storm MAT (Mitigation Assessment Team) and other assessment team observations. The engineers performed a "global" check on buoyancy and we cannot adequately decipher their calculations or see drawings to verify whether they adequately considered or addressed a local slab failure through buoyancy (i.e., uplift).

3) Although the engineer's letter, dated 5 March 2014, states that the project meets ASCE 24-05, no assumptions were provided explaining if or why hydrodynamic, debris impact, scour, erosion, and wave loads were not addressed in the calculations for this project. They should be considered in order to meet ASCE 24 requirements, especially considering this project is only one-tenth of a mile from the Gulf of Mexico.

4) Since we have seen only calculations for this project without context or drawings, it is unclear how they are handling seepage or other dry flood-proofing issues for the project.