



Memorandum

Project	FIU 8 th Street- Building Movement	BNI Job No	12M53
To	John M. Cal- FIU AVP Facilities Management	Date	Oct 14, 2015
From	Paul A. Zilio, PE	Page	1 of 3
Subject	Report regarding unusual movement of various campus buildings		

This memo addresses the unusual movements experienced by staff in several buildings at the Modesto Maidique Campus of Florida International University.

November 30, 2012

I was notified by Sylvia Berenguer, FIU's Director of Construction, that staff in a few buildings were reporting concerns of building tremors. Sylvia and I conducted interviews on campus on November 29th. Adding these interviews to prior emails and phone calls, a pattern began to emerge:

- Nearly all movements occurred between 9am and 3pm and lasted from 3 to 5 seconds (some were longer, depending on how each building/floor/location responded to the ground movement).
- Most of the people interviewed were located in the MARC Building, while only seven people were from AHC-1, 2 or 3.
- Most people were located on the 4th thru 6th floors.

I also walked the complete exterior and the public areas of all levels of the MARC and AHC-1, 2 and 3, looking for cracking that could be related to the movement. On the MARC and AHC-3, there were very few cracks, and all were narrow and cosmetic (non-structural). On AHC-1, and especially on AHC-2, there were a number of cracks in the stucco finish of the exterior walls. The cracks did not appear to be recent (they were dirty) and appeared to be cosmetic and non-structural. In speaking with John Cal, Sylvia Berenguer and others, I was told that these buildings have exhibited this cosmetic cracking for several years.

We initially considered, and ruled out, a wide number of possible causes of the movement, including building design and construction. On AHC-3, I was the Structural Engineer of Record and also the Threshold Inspector responsible for inspecting the structure and enclosure while they were being constructed. I also reviewed the design drawings of the MARC Building and did not have any concerns.

We also considered and ruled out construction activities for AHC-5 (adjacent to AHC-3). First, far more people reported movement in the MARC than the other buildings and the MARC is located the furthest from AHC-5. Further, the AHC-5 construction activities are very common and similar to those used for AHC-3 and the nearly-complete AHC-4 (I was the Structural Engineer of Record and Threshold Inspector for that project as well). We also had the geotechnical (earthwork) engineering firm of NV5 KACO review AHC-5 construction and

they concurred that, "The construction activities are typical and normal and are in no way related to the movements being felt in the MARC or AHC-1, 2 or 3."

Our investigation began to focus on blasting in rock quarry mines. One main reason is that blasting only takes place between 9am and 3pm and is typically felt for 3 to 5 seconds, consistent with virtually all described movements. There are a number of mines that blast to extract rock from the ground and some are located within four miles northwest of these FIU buildings. At the time of the interviews only four people had reported exact dates and times of feeling the movements, but it appeared those dates and times correlated to blasting at some nearby mines.

December 6, 2012

Following the issuance of John Cal's memo and the openness of this investigation, numerous FIU staff reported movement experienced on December 6th at 1:30 and described it as "stronger than previous occurrences". This was followed by even more widespread reporting of movement on December 11th at 1:30 and described as "stronger than December 6th". These reports were received from throughout the MARC, ACH-1, 2 and 3, as well as in Primera Casa, generally on floors 4 and above.

We were able to determine that the December 6th and 11th incidences exactly correlated to blasting at Vulcan Materials. The blasts took place northwest of their office address of 12201 NW 25th Street and more than three miles northwest of the FIU buildings. Vulcan acknowledged that they modified their procedure for these two blasts, which could explain why more people felt them compared with previous blasts. However, the ground vibrations from both blasts were below State of Florida limits as measured 1,800 feet from the blast. Note that, in order to protect the public and property, the State of Florida limit is well-below the vibration limit generally considered in the industry and engineering community as having the potential to cause structural damage to modern, well-constructed buildings. Given that these FIU buildings are almost ten times as far away, it is our professional opinion that ground vibrations from the blasting activities would not be sufficiently large to cause damage to buildings.

Human perception, however, is much more sensitive to vibrations. Extensive studies performed by the U.S. Bureau of Mines and many others have concluded that humans can perceive low level vibrations that are much lower than those that would cause even cosmetic damage to modern, well-constructed buildings. Additionally, this ability to perceive vibrations varies between individuals.

December 13, 2012

On December 12th we learned from Vulcan that they had a blast planned on December 13th and that they had modified their procedure. At the anticipated time of the blast, we arranged to have Sylvia Berenguer on the 5th floor of the MARC, Johnny Suggs of FIU's Environmental Health and Safety Department on the 6th floor of AHC-2, and me on the 5th floor of AHC-3. As Vulcan predicted, the three of us and those around us felt the movement, but described it as minimal. In fact, we only received one email about it.

After the blast I again walked the complete exterior and the public areas of all levels of the MARC and AHC-1, 2 and 3, and determined that neither did new cracks form nor, it appear, did the previous cracks enlarge. I also surveyed Primera Casa and found no cracking.

On December 17th I went to the 6-story (although shorter stories) Hampton Inn at 11600 NW 41st Street, approximately 2,200 feet from the site of the blast. The Property Manager and Building Engineer both confirmed that they routinely felt significant, blast-related vibrations. However, I observed the hard exterior and interior walls and exterior soffits and did not detect more than cosmetic cracking common in South Florida stucco walls.

January 9, 2013

KACO had previously been retained to monitor vibrations through sensitive equipment, but mines take a break from blasting until the New Year. KACO located equipment inside and outside of both the MARC and AHC-3 to monitor vibrations on January 9th and recorded vibrations until the equipment was removed on February 14th. The largest vibration their equipment measured was only 1.5% of the limit established by the United States Bureau of Mines as that having the potential for building damage. See KACO's separate report for more details.

October 9, 2015

On July 22, 2015 I was notified by FIU's new Director of Construction, Patrick Meagher, that staff in a few buildings were again reporting concerns of building tremors. The number and description of concerns was very similar to those reported in 2012.

I was provided with the design drawings for AHC-4 (where I was the Structural Engineer of Record and Threshold Inspector responsible for inspecting the structure and enclosure while they were being constructed) and AHC-5. My review of the design of each did not disclose any areas of concern related to mine blasting.

I again walked the complete exterior and the public areas of all levels of the MARC and AHC-1, 2 and 3, looking for cracking that could be related to the movement. The 2012 cracks did not appear to be meaningfully different, nor did I detect new cracks.

On my walk-thru of AHC-2, I was accompanied by Mr. Jose Rodriguez, Director of Facilities Operations, whose office is on the 6th floor and who has experienced some of the tremors now and in 2012. We went inside three penthouse level (equivalent to 7th floor) mechanical rooms. Each had unpainted masonry walls that were crack-free. This is consistent with findings in all buildings examined where there is not cracking beyond cosmetic in any building materials, including windows. Nonetheless, Mr. Rodriguez and I agreed that he would remove the interior finish behind one of the exterior stucco cracks to see if the backup masonry had cracks.

I did a similar investigation on the recently-completed AHC-4, AHC-5 and Mango Building (BNI was the Structural Engineer and Threshold Inspector, but I was not involved with the project). There are virtually no cracks evident in any of these three buildings.

Given the recent reports of tremors, Patrick Meagher, Oscar Irigoyen (FIU Sr. Project Manager) and I scheduled interviews with interested staff in MARC, Mango and AHC- 2 thru 5. All descriptions of building movement were consistent with mine blasting, specifically with White Rock Quarries South. In each interview I explained much of what we have learned regarding the effects of this mine blasting on people and buildings and assured that there are no life safety concerns.

Some people asked if these tremors could weaken the buildings long term. This would be similar to amusement park rides where a metal is subjected to cyclic stress that causes basic structural changes to occur. However, all of the buildings in question are constructed of reinforced concrete and the first step to weakening is cracking, and there is none evident.

Some people also asked about monitoring these buildings in the future to ensure there is plenty of warning if circumstances change. FIU FMD will continue to monitor buildings as part of its normal maintenance schedule and will engage a structural engineer for further analysis should abnormal cracking and signs of building distress develop.

This greater understanding generally put people at ease where they said they were no longer concerned.

Notes

Blasting is highly regulated by the State and County. The State Fire Marshall's regulations regarding Construction Materials Mining Activities can be found at: http://regs.cqstatetrack.com/info/get_downloaded_text?action_id=122446&text_id=51971&type=full_text. You can learn more about blasting at the Miami-Dade Limestone Products Association website, www.mdlpa.org. This website also includes the current weekly blasting schedule for all limestone quarries in Miami-Dade. I encourage those concerned with these vibrations to monitor this website to know when to expect blasting to occur. Blasting by others is also permitted but must meet the same standards and have a County permit. You can find the regulations governing blasting in the *Miami-Dade County Code of Ordinances – Chapter 13: Explosives* at: <http://miamidade.fl.eregulations.us/code/countylistview/3/6/2012/1C019216-1948-46C8-B1F3-461470CFFBDB/cbb80d56-2ca8-4c21-9350-b79d6e783071.html>.

Should you have any questions or concerns, or experience building movements that cause you concern, please contact me at p-zilio@bniengineers.com or (786) 269-5862.