

# **INSULAR ABC'S INITIATIVE**

## **Phase III Task 1 Findings and Recommendations Commonwealth of the Northern Mariana Islands**

October 2015



**US Army Corps  
of Engineers**  
Honolulu District



**Office of Insular Affairs  
US Department of Interior**



**HHF PLANNERS**  
*places for people*



## Background

The US Office of Insular Affairs (OIA) Insular ABCs Initiative is a multi-phase effort being managed by the US Army Corps of Engineers, Honolulu District via its contractor, HHF Planners. It is a collaborative effort with Insular Governors focused on improving the physical conditions of Insular Area public schools (Commonwealth of Northern Marianas, Guam, American Samoa and the US Virgin Islands).

The project is now in its third and final phase focused on removing the Deferred Maintenance (DM) backlog identified in Phase II. Assessments and recommendations for school sites and buildings were divided amongst four disciplines:

- Architectural
- Structural
- Mechanical, Electrical, Plumbing, and Fire Alarm (MEPFA)
- Civil

The purpose of the Phase III investigation was to:

- Receive updated input from cognizant local agencies and other stakeholders related to school conditions and priorities
- Confirm and review DM work completed since the Phase II condition assessment (2013)
- Update condition assessments for elements of concern
- Evaluate new Health/Safety issues
- Discuss and review issues of particular concern with cognizant local agencies
- Gather information on issues/elements of concern to develop and refine project recommendations to be included in the Work Plan.

This report includes Phase III findings and recommendations for Architectural, Structural, and MEPFA building system conditions. Civil engineer findings and recommendations are addressed in a separate report.

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ARCHITECTURAL SUMMARY REPORT  
COMMONWEALTH OF THE NORTHERN MARIANA  
ISLANDS  
October 2015

Prepared by:  
Mason Architects, Inc.

## I. PRIORITIZATION PRIOR TO PHASE 3 SITE VISIT

The Phase 2 survey produced ratings for various Architectural elements, as well as identification of Health and Safety issue. Prioritization of Architectural projects for Phase 3 was compiled from the results of the Phase 2 surveys, based on building element conditions and the potential hazards to building users. The order of priority for projects based on the Phase 2 observations were: conditions that pose an immediate hazard to the health and safety of the building occupants, conditions that if left unrepaired may cause damage to other building components or its contents, and other maintenance and repair projects. The table below shows the architectural elements found in the Phase 2 survey with Health and Safety concerns.

SCHOOL	BUILDING	HEALTH/SAFETY ELEMENT
Dandan Elementary School	02-Cafeteria	Downspout enclosure
Garapan Elementary School	06-Classroom	
Hopwood Jr. High School	17-LMA Classroom	
Marianas High School	01, 02, 03, 04, 06-Classrooms	Exterior stair
	06-Classroom	Covered Walkway spalling
Oleai Elementary School	12-Bus Shelter	Rusted roofing
Rota Jr./Sr. High School	08-Mechanical Shop	Concrete ceiling spalling
Saipan Southern High School	07-Library	Rusted gutter
San Vicente Elementary School	04-Classroom	Metal roofing failing
Tinian Jr./Sr. High School	11-Cafeteria	Exterior stair metal handrail

## II. SUMMARY OF PHASE 3 MEETINGS AND SCHOOL VISITS

The purpose of the Phase 3 territory visits was to:

- Get input from DOE and other stakeholders
- Confirm and review DM work completed since the Phase 2 visits
- Update condition assessments of elements of concern
- Evaluate any new Health/Safety issues
- Discuss and review issues of particular concern to DPW
- Gather information on issues/elements of concern to develop project recommendations

Based on concerns developed during our Phase 2 survey, as well as additional concerns expressed by the DOE and stakeholders to the project team prior to or during the Phase 3 visit, the following schools were re-visited during the March 2015 visit:

- Marianas HS
- Oleai ES
- San Vicente ES
- Saipan Southern HS
- Koblerville ES

- Reyes ES
- Hopwood JHS
- CT Camacho ES
- Tanapag MS
- Garapan ES
- Chacha MS
- Kagman HS
- Kagman ES
- San Antonio ES

### III. OBSERVATIONS AND ADDITIONAL INFORMATION FROM PHASE 3 VISIT

#### A. TERMITE TREATMENT

Several of the CNMI schools reported moderate to extensive termite damage to wood building components, finishes and furniture. The damage seems to be more prevalent at coastal schools, such as Hopwood Junior High, San Antonio Elementary, and Tinian Junior/Senior High Schools. DOE and DPW staff indicated that the tenting extermination method, in which an entire building is enclosed in a tent and the entire building is fumigated, is not available in CNMI. They also stated that at coastal schools, spraying on the ground surfaces is not allowed due to the proximity to the water table and ocean. There are other types of termite treatment available, such as baiting systems and Termidor-type product which are applied where termites are found. It is important to be diligent and proactive about termite control, as damage typically spreads mostly unseen, and can be costly to repair if left untreated.

#### B. PHASE 3 OBSERVATIONS

Following are descriptions of observations at the Saipan schools that were visited in the Phase assessment update:

##### 1. Marianas HS

Spalls at Building (6) were repaired by a contractor, and appear to be adequate.

Gutters were removed from the covered walkway. In some locations the downspout is leaking, causing mold to form at the walkway rafters.



Roofs at buildings 1-4 (A-D) were patched [product: Roofmate, same product as 2013 roofing projects]. The previous roofing was done in 2005; these buildings were not reroofed in 2013. A new stainless steel gutter was installed at the eaves above the covered walkways. Some roofing repairs were done at the Gym by a contractor, but there is still some leaking.

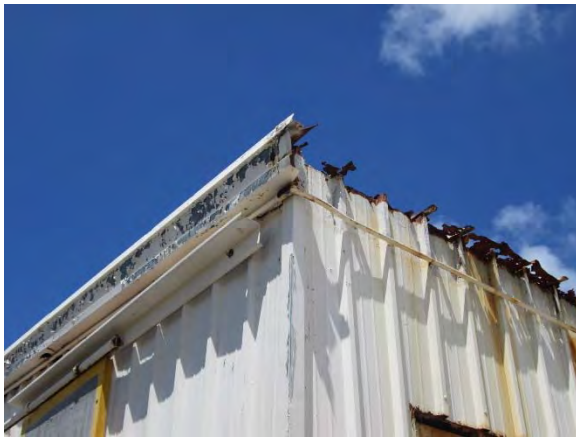


At the covered eating area adjacent to the cafeteria, a student project added a roof vent.

The steel spiral fire escape stairways at Buildings 1-4 and 6 (A – E) have corroded further. Plywood was installed at the top landing platform due to the corrosion of the floor plate, but there is extensive corrosion in the plate and the steps and handrail connections are also rusting. The plywood has helped to reduce the safety hazard, but the top landing plate should be replaced, and the stairways should be cleaned, the rust removed, and they should be painted to help slow further deterioration



Building 16 (T-south) and 14 (T-north) buildings are still in poor condition. School staff stated that they would like to repair the buildings and use for storage. The metal roofing and siding is rusted and in poor condition, and the steel columns at T-south would require repair.



## 2. Oleai ES

The Bus Shelter (Bldg 12) roof that was identified in Phase 2 as unsafe was mostly removed, with a small portion remaining to offer some rain protection. It is no longer a safety hazard.



Building 11 is still in disrepair; the roof structure and roofing is going to be replaced.

The roofing at Buildings 5 and 7 is still in poor shape and has rusted further. No reroofing work has been done here since the Phase 2 survey.

Two historic WWII Japanese water tanks are located on the east side of the campus near Building 3. One has a tree growing out of the middle of the structure; this should be removed to prevent further damage to the structure. The water tanks should be monitored and plants, trash and debris removed to help extend the life of the historic structures.



### 3. San Vicente

Some concrete repairs at the metal entry ramp leading to Building 4 (A) helped with the drainage and have provided some support for the structure. The ramp could use some additional support (see structural report), and the floor plate is rusting. Portions of the handrail have rusted holes, which could cut people's hands and is a safety hazard, and should be patched. The bottom of the handrail is also rusting and will eventually become loose. Due to these multiple issues, plans for replacement of the ramp should be put in place.



Several portions of the covered walkway have been demolished, and additional portions will also be removed, as it is in poor condition.

The roofing over the office (Building 9) is still in poor condition, but new flashing was installed between the metal and concrete roof, which has for now stopped the leaking.



Concrete was installed over the rusted metal stair at building 4. This appears to be functional, except that the top and bottom steps are not equal in height to the other steps (which violates building code).



Building 10 (K) still has concrete spalls at the columns and walls.



#### 4. Saipan Southern High School

The metal gutters that were noted in the Phase 2 survey as extensively deteriorated have not been removed or replaced, although portions of the rusted metal that were dangling were removed. More of the gutters have rusted, and they are still a safety hazard. The damaged portions of the gutters should be removed. Due to the failed gutters, water continues to pour onto the buildings when it rains, potentially causing damage to the building exterior and interior elements. The gutters should be replaced.



The metal roofing should be periodically painted to extend its life.

Water has been periodically found on the Library interior floor; it is not apparent if the water is coming through an inadequate window seal, from the wall above, or from the exterior wall where the finish system has been damaged, most likely from maintenance staff using weed whackers. Some patching was done to the window seal, but the leaking persists.



## 5. Koblerville ES

Some work has been done to repair the covered walkways, while parts are still damaged and need repair. Some of the spalled areas at the concrete floor have been patched.



The roof structure and roofing at Building 12 is still in poor condition and should be replaced.





## 6. Reyes Elementary School

The roofs are leaking at buildings 2, 5 and 8 (D, E, F). The maintenance staff said that it appears that when the previous roofing was removed, nails were left in the sheathing, which perforated the new corrugated metal roofing and is causing the leaks. Roof leaks in the Cafeteria are likely from poor seals around the roof drains, as leaks are isolated to the roof drain locations.



Building 12, the Maintenance building, is still in poor condition. Whether or not this building will be repaired and retained is undecided, but the building is currently full of stored items that can't be thrown away and must be properly disposed of (like computers), so likely nothing will occur until these items are dealt with.



The Canteen (Building 17) is still in poor condition, and although it is still in use, it is being considered for demolition. The exterior siding is termite damaged, and it is likely the building structure is also termite damaged.



7. Hopwood Junior High School

The school has problems with termites, and several buildings including 2, 4, 7, 8, and 10. Termites are causing damage to building structure, interior walls, furniture and books in the classroom. School staff stated that they are not permitted to spray termite treatment on the ground due to the proximity to the ocean.



The covered walkway roof structure at Building 6 is sagging; there is no beam under the rafters, just a flat 2x8 support.

Buildings 15 and 17 are still in poor condition; the school is still deciding to repair or demolish them. The eave is broken and collapsing at the west side of building 15; this is a safety hazard and should be repaired.



At the covered space on the west side of Building 10, the rafters collapsed; the maintenance staff sistered new rafters on and added some posts, but additional supports should be installed.



At Building 7 (M), termite damage and a hole in the roofing has created a large hole in the roof, which is allowing water in. This is causing damage to the building structure and interior finishes, and it should be repaired if this building is to be used in the future.





The deterioration of the corrugated metal roofing at Building 9 is likely being accelerated by the pine needles that collect on the roof, deposited there by a nearby Ironwood tree. The needles should be cleaned off, particularly in wet periods, to help prolong the life of the roofing.



Some existing siding at the gable end wall of Building 2 (A) appears that it might be corrugated asbestos. The material should be tested prior to any renovation, repair or demolition work that would affect this material.

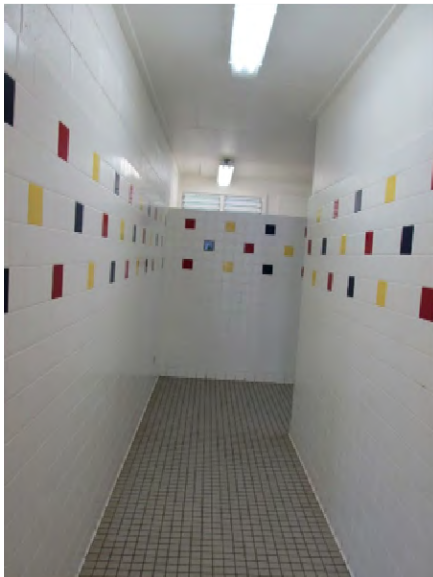


#### 8. GT Camacho ES

The roofing at Building 2 is in poor condition; reroofing is planned for the summer 2015, and is reportedly under warrantee.



The maintenance area behind the Cafeteria received new roofing and gutter, as has the covered walkway leading from the restroom (4) to Building 2. The restrooms (4) have been renovated on the interior, and have new roofing. Building 1 has also been reroofed.



9. Tanapag MS



Building 10 (J) is currently under renovation. The bathroom (Building 9) has new roofing and has been renovated on the interior. Concrete spalls on this building were repaired by a contractor.



Building 13 (F) also has new roofing, installed in 2013, but needs new plywood at the soffit.



The restroom in Building 5 (B) was also renovated on the interior. New fencing was installed around the school. Building 7 (C) needs new roofing.



10. Garapan ES

Some interior work has been completed on Building 10, but the exterior still has spalling at the exterior stairs, walls, and awning. The door on the east side of the second floor has swollen from moisture and is unopenable.



Buildings 1 (C), 4 (A), and 9 (stage) have all received new corrugated metal roofing.

11. Chacha Middle School

The roofing at all of the buildings is failing, and some of the buildings have roof leaks.



At the Library (Building 2), it is leaking around the windows in the corner of the main room. It appears to be from poor seals in the sash frames not able to keep out wind-driven rain.



Building 5 (A) has some wall cracks that are leaking on the interior. These should be sealed on both the interior and exterior when the wall is able to dry out as much as possible. The ledge at the exterior wall above where the cracks are should also be sealed to help prevent the wall from becoming saturated.

12. Kagman High School

No new issues were observed at this school except for the failure of some of the roofing, mostly at the top of the gabled roofs.



13. Kagman Elementary School

There are signs of some roof leaks, mostly isolated to the location where sloped roofs meet the flat roof of the exterior walkway. The exterior downspouts, noted as deteriorated in the Phase 2 survey, have not been repaired and have continued to deteriorate. The uncontrolled water is damaging the building exterior.





#### 14. San Antonio Middle School

This school has been converted to a middle school, and some alterations will take place this summer to accommodate that.

Building 10 is still abandoned and has received no repairs. The school has put in a request for demolition funding.

Maintenance staff stated that there are currently no roof leaks, but deteriorated metal roofing was noted in the covered walkways, and Buildings 9 and 13.



Termite damage is prevalent; the ground bait system and spot treatment are currently being used.

#### IV. ADJUSTMENTS TO PRIORITIZATION

The table below provides a summary of Health and Safety issues identified in the Phase II and Phase III assessments. Where Phase II Health and Safety items were repaired/addressed, they were removed from the list. The Phase III assessments entailed rapid observations, and not all schools were visited nor were all buildings at each school re-surveyed. Some other safety issues not listed below may still exist.

SCHOOL	BUILDING	HEALTH/SAFETY ELEMENT
REMAING FROM PHASE II		
Dandan Elementary School	02-Cafeteria	Downspout enclosure
Garapan Elementary School	06-Classroom	
Marianas High School	01, 02, 03, 04, 06-Classrooms	Exterior stair
Rota Jr./Sr. High School	08-Mechanical Shop	Concrete ceiling spalling
Saipan Southern High School	07-Library	Rusted gutter
San Vicente Elementary School	04-Classroom	Metal gutter failing
Tinian Jr./Sr. High School	11-Cafeteria	Exterior stair metal handrail
NEW FROM PHASE III		
Hopwood Jr. High School	15	Falling eave
San Vicente Elementary School	04-Classroom	Rusted metal handrail

#### V. RECOMMENDATIONS

Following are descriptions of Architectural Health and Safety Issues of prominent concern, as well as some other repair issues, along with recommended repair solutions.

These recommended projects are provided as a means to assist in accelerating the time to complete these projects by providing identification of prominent issues as well as suggested solutions.

##### 1. Rusted metal railing

Location: San Vicente Elementary School, Building 4

Portions of the handrail have rusted holes, which could cut people's hands and is a safety hazard. The bottom of the handrail is also rusting and will eventually become loose



**Recommended Scope of Work:**

Where railings are rusted at the base, the railing should be removed and re-welded

- Cut railing off at each base and remove railing
- Removed rusted portion of the base
- Weld new base to ramp and then weld base to railing, ensuring that railing height meets building code requirements.

Where railings are rusted at other locations:

- Remove rusted metal and clean rail surface
- Weld railing as required to repair rusted areas and holes

**2. Isolated areas of deterioration of Fluid-applied roofing**

Location: GT Camacho Elementary School, Building 2; Chacha Middle School, all buildings

The roofing at Building 2 is in poor condition; reroofing of is planned for the summer 2015, and is reportedly under warrantee. If the roofing contractor is not able to replace or repair the existing roofing, it must be patched in order to help prevent leaking below.



The roofing can be patched, but will likely last only a few years at the maximum before the entire roof should be re-roofed.

To patch deteriorated area:

- Remove areas of peeling or bubbled roofing
- Thoroughly clean exposed roof surface and roofing around area to be patched
- Install new roofing patches according to manufacturer's directions

### 3. Spalling concrete (non-structural elements)

Location: Garapan Elementary School, Building 10

The concrete is spalling at several locations at this building. The spalling is typically caused by moisture getting into the concrete and rusting the steel reinforcing, which expands as it rusts and causes the concrete to crack and eventually break off. Where cracked and spalling concrete is on ceilings or is on columns or walls above, it is a safety concern as they create a falling hazard to the building occupants.



Recommended Scope of Work:

To repair non-structural concrete spalling, the following steps should be taken:

- Remove all loose concrete
- Remove as much rust as possible from steel reinforcing elements
- Replace reinforcing as necessary. Consider using fiberglass reinforcing bars
- Treat steel with a rust-preventing compound
- Fill all cracks and patch spalls with new concrete

### 4. Rusted Fire Escape

Location: Marianas High School, Building 1, 2, 3, 4, 6

The steel spiral fire escape stairways at Buildings 1-4 and 6 (A – E) are extensively corroded, particularly at the top landing. Plywood was installed at the top landing platform due to the corrosion of the floor plate, but there is extensive corrosion in the plate and the steps, and handrail connections are also rusting. The plywood has helped to reduce the safety hazard, but the stairs need to be repaired or replaced.





**Recommended Scope of Work:**

The rusted top landing floor plates should be replaced:

- Remove existing floor plate
- Examine landing structure to determine integrity, and repair if required
- Install new galvanized steel floor plate.
- The stair treads should also be examined and replaced or repaired where needed
- Establish schedule for repainting to prolong life of stair

MECHANICAL, ELECTRICAL, PLUMBING, AND FIRE PROTECTION  
SUMMARY REPORT  
COMMONWEALTH OF THE NORTHERN MARIANA  
ISLANDS  
October 2015

Prepared by:  
InSynergy Engineering, Inc.

## I. PRIORITIZATION PRIOR TO PHASE 3 SITE VISIT

The initial physical assessment of all of the CNMI public schools was conducted in 2013 under Phase II of the ABC's Initiative. Based on these surveys, physical condition assessment ratings were developed for the various MEP elements of each of the CNMI public schools. The locations of particular types of concerns based on condition assessment data are summarized in the following table:

School	HVAC – Outside Air Provision	HVAC - Maintenance	HVAC - Equipment	Building Insulation	Plumbing System	Plumbing Fixtures	Water Tank & Booster Pump	Electrical System	Electrical Hazard	Interior Lighting	Exterior Lighting	Telecommunications/Data	Fire Pump System	Fire Alarm	Public Announcement (PA) System	Total
Chacha Oceanview Jr. High	X	X	X				X			X	X			X	X	8
Dandan Elementary	X					X	X			X	X				X	6
G.T. Camacho Elementary	X					X	X	X		X	X			X	X	8
Garapan Elementary	X			X		X	X	X		X	X	X		X	X	10
Hopwood Jr. High	X	X		X		X	X	X		X	X			X	X	10
Kagman Elementary	X	X	X			X	X	X	X	X	X			X	X	11
Kagman High	X	X	X			X	X	X		X	X			X	X	10
Koblerville Elementary	X								X		X			X	X	5
Marianas High	X	X	X	X		X	X	X	X	X	X	X	X	X	X	14
Oleai Elementary	X	X	X	X		X		X		X	X			X	X	10
Reyes Elementary	X	X	X	X		X	X	X		X	X			X	X	11
Rita H. Inos Jr. High	X									X	X			X	X	5
Rota High	X					X		X	X	X	X			X	X	8
Saipan Southern High	X	X	X	X		X					X			X	X	8
San Antonio Elementary	X	X		X		X	X	X		X	X			X	X	10
San Vicente Elementary	X	X									X	X		X	X	6
Sinapalo Elementary	X			X							X			X	X	5
Tanapag Elementary	X	X		X	X		X	X		X	X			X	X	10
Tinian Elementary	X					X		X	X	X	X			X	X	8
Tinian Jr./Sr. High	X							X	X		X			X	X	6
<b>Total</b>	<b>20</b>	<b>11</b>	<b>7</b>	<b>9</b>	<b>1</b>	<b>13</b>	<b>11</b>	<b>13</b>	<b>6</b>	<b>15</b>	<b>20</b>	<b>3</b>	<b>1</b>	<b>19</b>	<b>20</b>	<b>169</b>

The phase II assessment also identified the high priority Health and Safety (H/S) items which pose an immediate hazard to the health and safety of the building occupants. H/S items are summarized in the table below:

System	Electrical									Plumbing & Sanitation		Mechanical		Fire Protection			Total
Hazard	Shock	Shock	Shock	Shock	Life Safety	Shock	Health	Safety	Life Safety	Health	Sanitation	Health	Indoor air Quality	Life Safety	Life Safety	Fire	
Causes	Overhead service lines not properly secured, running on top of roof slab	Water leaking onto lighting, electrical equipment	Exposed or open receptacles, junction boxes, wall switches, wireways, corroded wiring and conduits, exposed conductors	Panelboard is in poor condition, not rated for outdoor use, corroded, missing breakers, cover, exposing wiring	Inappropriate material used for conduit (PVC)	No GFCI for receptacle at outdoor, wet area, drinking fountain	Interior lighting fixtures missing covers, corroded and worn	Exterior lighting not rated or appropriate for external use, not weatherproof, missing cover	PV inverters not in secure location without adequate clearances	Inoperable water pumps, lift station	Insufficient number of bathroom fixtures available for student load	Bathroom has no ventilation	Corroded large package units, ductwork leaks	Fire alarm/sprinkler/fire pump system not operational, corroded or damaged	Fire alarm/sprinkler/fire pump system non-existent	Inadequate fire resistance protection at chimney	Total
School																	
Cha Cha Ocean View Junior High																	0
Dan Dan Elementary																	0
G.T. Camacho Elementary			X	X	X												3
Garapan Elementary			X	X				X			X						4
Hopwood Jr. High			X														1
Kagman Elementary	X	X				X	X	X					X	X			7
Kagman High																	0
Koblerville Elementary	X		X														2
Marianas High	X							X		X		X		X			5
Oleai Elementary							X				X						2
Reyes Elementary			X							X							2
Rita H. Inos Junior High																	0
Rota High			X	X											X		3
Saipan Southern High			X						X					X		X	4
San Antonio Elementary			X					X									2
San Vicente Elementary			X		X			X									3
Sinapalo Elementary														X			1
Tanapag Elementary			X		X							X					3
Tinian Elementary			X	X													2
Tinian Jr./Sr. High				X										X			2
<b>Total</b>	<b>3</b>	<b>1</b>	<b>11</b>	<b>5</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>5</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>5</b>	<b>1</b>	<b>1</b>	<b>46</b>

## II. PHASE III SCOPE OF WORK AND FOLLOW-UP MEETINGS AND SCHOOL VISITS

The Phase III scope included refining and confirming the high priority mechanical, electrical, and plumbing (MEP) concerns from the Phase II assessments, coordinating these MEP priorities with needs from other disciplines at a building level and developing conceptual multidisciplinary projects that would allow some of the repair or replacement work to be grouped for more efficient implementation

As part of Phase III, additional field survey work was conducted from April 27 – May 1, 2015. The purpose of the Phase III territory visits was to:

- I. Get input from CNMI PSS and other stakeholders, including the CNMI Department of Energy, Commonwealth Utilities Corporation (CUC), and the Commissioner and Fire Captains of CNMI Fire and Emergency Medical Services, and CNMI Emergency Management Office.
- II. Confirm and review DM work completed since the Phase II visits
- III. Update condition assessments of elements of concern
- IV. Evaluate any new H/S issues
- V. Discuss and review issues of particular concern to CNMI PSS
- VI. Gather information on issues/elements of concern to develop project recommendations
- VII. Review and update the energy audit assessment

Based on concerns developed during our Phase II survey, as well as additional concerns expressed by the CNMI PSS and stakeholders to the project team prior to or during the Phase III visit, the following schools were re-visited during the April 2015 visit:

- Marianas High School
- Garapan Elementary School
- Tanapag Elementary School
- San Vicente Elementary School
- Dandan Middle School
- Kagman Elementary School
- Kagman High School
- Chacha Oceanview Middle School
- Hopwood Junior High School
- Koblerville Elementary School
- Saipan Southern High School

### III. OBSERVATIONS AND ADDITIONAL INFORMATION FROM PHASE III VISIT

A majority of the MEP DM items identified in Phase II have not been completed, including most of the high priority MEP H/S items.

The primary concern raised during the survey work was that all of the fire alarm systems at the schools were inoperable due to numerous troubles and silenced fire alarms. The inoperable fire alarm devices that were previously noted in Phase II have not been restored to full functionality due to the unavailability of parts for the older systems that were installed, and due to lack of service maintenance support from qualified fire alarm service providers. Based on these findings, and additional concerns raised by the fire department on this issue, the repair and replacement of the fire alarm systems has been elevated to a high priority MEP H/S item.

CNMI Emergency Management Officer (EMO) explained that single phase 240Vac emergency shelter standby electrical power generators with trailers and strip lights would be delivered to emergency shelters. Standby generators would supply power to booster pumps to deliver domestic water for sanitation purposes. Bottled water would be delivered as well.

Additional Energy Conservation Measure (ECM) improvements were also completed as noted in Section V., the Energy Audit Assessment Update.

Following is a summary of the schools visited and the issues noted at each school:

#### A. Marianas High School

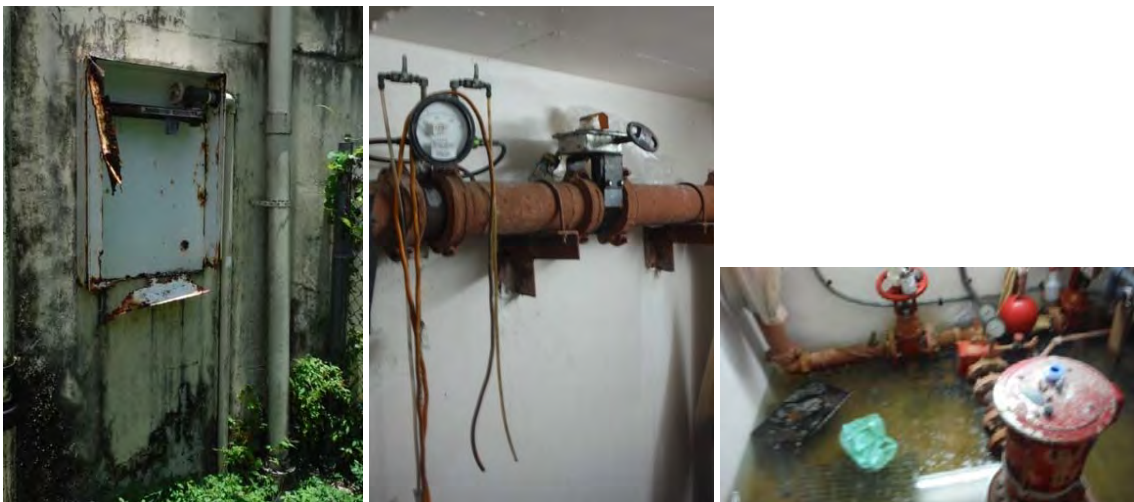
##### 1. Fire alarm system

OIA Phase III survey found the fire alarm panel had trouble signals. The fire alarm system required services and repairs to ensure its functions and performance meet fire safety requirements.



## 2. Building 19 - Gymnasium

OIA Phase II survey found the fire pump, fire controller and fire hose system were inoperable. Fire pump was installed in a below grade pit that flooded. OIA Phase III survey found these fire safety systems remained inoperable. The pump pit is subject to flooding, and the inoperable fire pump and fire hose are safety hazard to the occupants. Fire protection system should be properly and regularly serviced and maintained.



OIA Phase II survey found the duplex domestic water booster pumps were installed in a below grade pit where was flooded. OIA phase III survey found only one booster pump was operable. The pump pit was flooded. The failure of booster pump was because of lack of low suction water pressure protection and the flooded pit. The water entering into the pit came from the adjacent cistern through the pipe penetrations. It was a safety and health hazard to the occupants. The leak at pipe penetration should be repaired. The booster pumps should have proper low suction water pressure protection and controls. Pumps, motors and control components should be away from flooding not unless they were made and installed for submersed environments. Booster pumps should have provision to hook up to emergency shelter standby electrical power generator provided by CNMI EMO if the school would be used as emergency shelter.





B. Garapan Elementary School

1. Fire alarm system

OIA Phase III survey found the fire alarm panel had trouble signals. The fire alarm system required services and repairs to ensure its functions and performance meeting the fire safety requirements.



OIA Phase III survey found some manual pull stations were obstructed. The manual pull stations should be conspicuous, unobstructed and accessible.

2. Electrical/lighting:

Building 02 Cafeteria

OIA Phase III survey found that some lighting fixtures were not functioning. Light bulbs need replacement.

General Walkway Area

OIA Phase III survey found that walkway light bulbs should be replaced.



Building D:

OIA Phase III survey found that lighting fixtures have been replaced.



C. Tanapag Elementary School

1. Fire alarm system

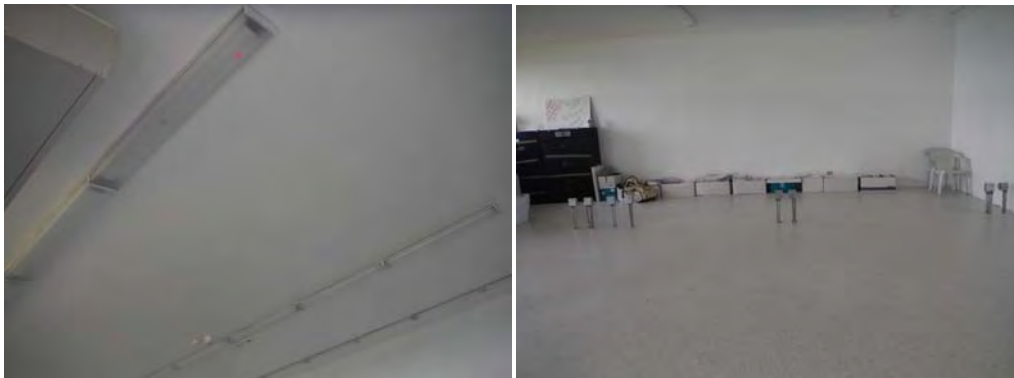
OIA Phase III survey found the fire alarm panel power was off. This condition poses a safety hazard to the occupants. The fire alarm system requires servicing and repairs to ensure that functions and performance meet fire safety requirements.



2. Electrical/lighting:

Building 13-F

OIA Phase III survey found that the building interior was renovated.





#### Building 09-I

OIA Phase III survey found that lighting fixtures have been replaced.

OIA Phase III survey found that plumbing fixtures, both sinks and stalls, have been replaced in men and women's restrooms.

#### Building 02 Bus Shelter

OIA Phase III survey found that lighting fixtures have been replaced. Weather proof covers have been installed on receptacles.



#### D. San Vicente Elementary School

##### 1. Fire alarm system

OIA Phase III survey found the fire alarm panel power was off. This condition poses a safety hazard to the occupants. The fire alarm system requires servicing and repairs to ensure it functions and performs per fire safety requirements.



2. Building 04-A:

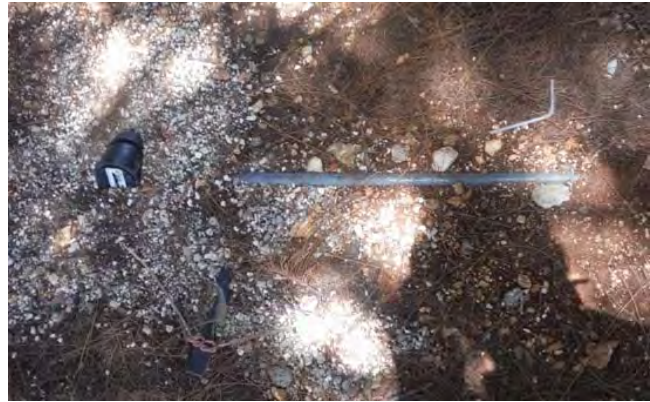
OIA Phase III survey found that the service disconnect on the exterior of the building is padlocked in the closed/on position.

OIA Phase III survey found that the building's ground floor receptacles have been replaced.



3. Building 2

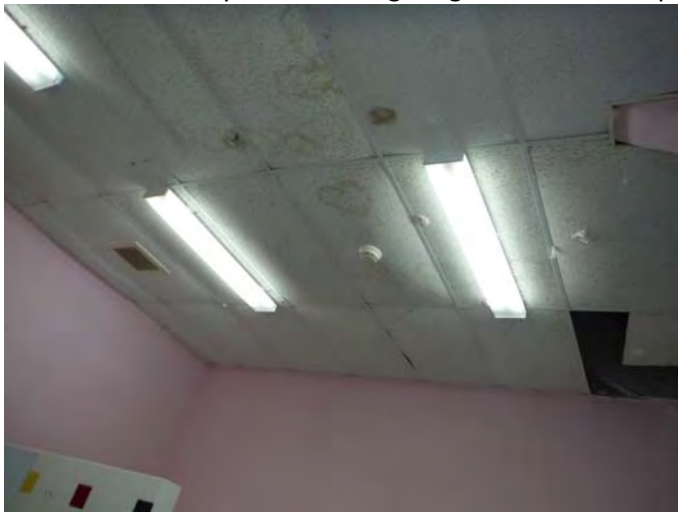
OIA Phase III survey found the newly installed buried plumbing piping to the outdoor hand sinks were too shallow and partially exposed. The exposed buried piping would be damage without proper coverage and pose a tripping hazard to the occupants.



4. Electrical/lighting:

Building 13-H

OIA Phase III survey found that lighting fixtures were replaced.



E. Dandan Middle School

1. Fire alarm system

OIA Phase III survey found the fire alarm panel power was off. Wires were removed from the fire alarm panel terminals. This condition poses a safety hazard to the occupants. The fire alarm system requires servicing and repairs to ensure it functions and performs per fire safety requirements.

2. Electrical/lighting:  
Service Connection  
OIA Phase III survey found that each building has a dedicated electrical service connection.



#### Building 04-A

OIA Phase III survey found that men and women's restroom lighting fixtures were replaced.



#### F. Kagman Elementary School

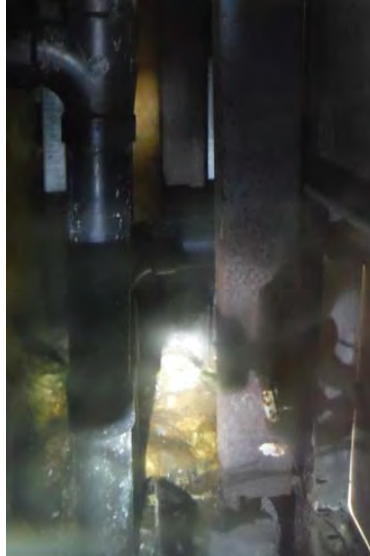
##### 1. Fire alarm system

OIA Phase III survey found the fire alarm panel was power-off. It was a safety hazard to the occupants. The fire alarm system required services and repairs to ensure its functions and performance meeting the fire safety requirements.



2. Building 6

OIA Phase III survey found some steel carriers of plumbing fixtures were broken due to corrosion. The steel carriers should be replaced in order to support the plumbing fixtures. The broken fixture carriers posed safety and health hazard to the occupants.



3. Electrical/lighting:



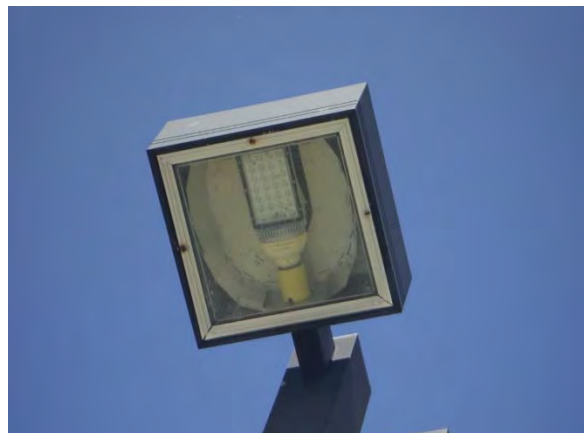
#### General Walkway

OIA Phase III survey found that walkway lights were inoperable.



#### Parking

OIA Phase III survey found that parking lights were inoperable.



### Building 5 Cafeteria

OIA Phase III survey found that cafeteria high bay lighting dims green.



### G. Kagman High School

#### 1. Fire alarm system

OIA Phase III survey found the fire alarm panel had trouble signals. Some manual pull stations were required service and reset. It was a safety hazard to the occupants. The fire alarm system required services and repairs to ensure its functions and performance meeting the fire safety requirements.



#### 2. Building 16, water tank

OIA Phase III survey found the municipal water directly supplied domestic water to the school. School did not have single phase booster pump to be hooked up to emergency shelter standby generator provided by CNMI EMO. Water tank overflowed and caused soil erosion at the discharge. It should be corrected.

### H. Chacha Oceanview Middle School

#### 1. Fire alarm system

OIA Phase III survey found the fire alarm panel power was off. This condition poses a safety hazard to the occupants. The fire alarm system requires servicing and repairs to ensure its functionality and performance meet fire safety requirements.



2. Building 7, Classroom  
OIA Phase III survey found smoke detector installed at unconditioned space which would likely result in false alarms or other system trouble. Fire alarm system should be serviced and maintained by qualified contractors to avoid and correct the false alarms and system troubles.



I. Hopwood Junior High School

1. Fire alarm system  
OIA Phase III survey found the fire alarm panel had trouble signals. The fire alarm system required services and repairs to ensure its functions and performance meeting the fire safety requirements.



2. Building 3, Office  
OIA Phase III survey found smoke detector did not secured. Fire alarm system should be serviced and maintained by qualified contractors to avoid and correct the false alarms and system troubles.



3. Building 22, Classroom

OIA Phase III survey found manual pull station was pulled. Fire alarm system should be serviced and maintained by qualified contractors to avoid and correct the false alarms and system troubles.



4. Electrical/lighting:

Building 03

OIA Phase III survey found that exterior receptacles should be GFCI installed with a weatherproof cover.



Building 22-B2

OIA Phase III survey found that panel board should be replaced.



Building 6-C

OIA Phase III survey found that two receptacles on the exterior side of the building should be removed.





OIA Phase III surveys found that there are exposed wiring on the corridor ceiling.



OIA Phase III survey found CUC service line is too low.



Building 20- PE

OIA Phase III survey found that meter service disconnect box cover needs replacement.



J. Koblerville Elementary School

1. Fire alarm system

OIA Phase III survey found the fire alarm panel had trouble signals. The fire alarm system required services and repairs to ensure its functions and performance meeting the fire safety requirements.



2. Electrical/lighting:  
Building 02-C

OIA Phase III survey found an inoperable telecommunication box outside room C-16.

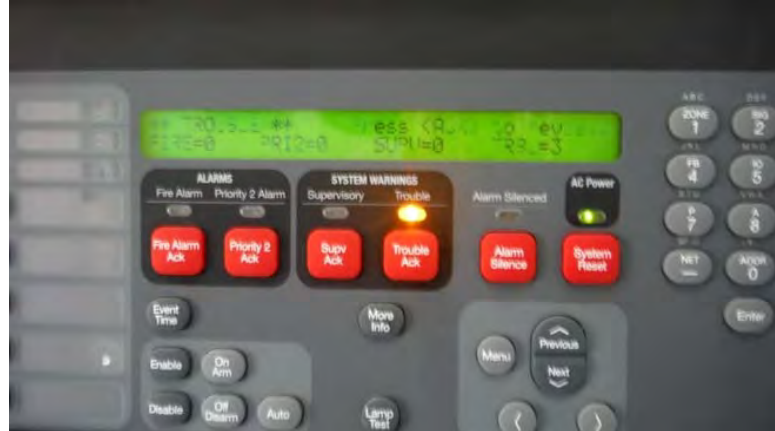




K. Saipan Southern HS

1. Fire alarm system

OIA Phase III survey found the fire alarm panel had trouble signals. The fire alarm system required services and repairs to ensure its functions and performance meeting the fire safety requirements.



2. Building 8, Classroom

OIA Phase III survey found the new flush valve did not operate properly. They needed adjustment or replacement.



3. Electrical/lighting:

General Walkway

OIA Phase III survey found that some lighting fixtures have been damaged due to water leaks.

Building A and B:

OIA Phase III survey found that walkway lighting is inoperable between buildings.



#### IV. ADJUSTMENTS TO PRIORITIZATION

While few of the MEP Health and Safety issues noted in Phase II were known to have been repaired, the site visits in Phase III added some additional issues to the list of MEP Health and Safety issues. .

The revisions to the MEP DM physical condition assessment scoring, and to the H/S list based on our Phase III follow-up work were made to the database and are summarized as follows:

1. Changed most of the fire alarm repair work from level 4 DM items to high priority H/S items

#### V. ENERGY AUDIT ASSESSMENT UPDATE FOR PHASE III

##### 1. Recap of Phase II Energy Audit Findings

The chart below (p. 20 in the Phase II report) provides an overview of the energy conservation measures (ECMs) that were initially recommended for CNMI. At that time, the total annual savings was estimated at \$1.3M (2013 dollars) at a total investment cost of \$1.3 M for the Primary ECMs that were recommended.

Energy Audit ECM Recommendations	CNMI
<b>ECMs - Electric</b>	
New Solar Hot Water or Heat Recovery System	
Replace T12 Fixtures with T8 LED	
Replace T8 Fluorescent Lamps with T8 LED	
Programmable Thermostats for AC	
Roofmount 30-200 KW PV system	
Fix Supply Air Discharge Duct Leaks	
New Lighting Controls	
New VFDs/High Efficiency Booster Pump Motors	
New Heat Recovery/ Desuperheater System	
Insulate Non-insulated Roofs	
Replace AC Systems with High Efficiency Units	
Retrofit with Ultra Low Flow Plumbing Fixtures	
<b>Total Investment (\$M) - Primary ECMs</b>	\$11.3
<b>Simple Payback (years) - Primary ECMs</b>	7
<b>Investment Capitalization (years) - Primary ECMs</b>	10
<b>Dollar Savings (millions per year) - Primary ECMs</b>	\$1.5
<b>Percent Reduction in Utility Costs - Primary ECMs</b>	40%
	ECM Recommended – Primary Recommendation
	ECM Recommended– Other, feasible if funding permits
	Not proposed

##### 2. Updated Phase II Energy Audit Analysis

Based on our follow-up survey, several ECM's have been implemented, primarily for replacing T-12 with T-8 lighting. Our updated analysis, which has been revised to reflect the implementation of T-8 lighting retrofits, and selective replacement with low flow plumbing fixtures in CNMI, is summarized in the table below:

Energy Audit ECM Recommendations	CNMI
<b>ECMs - Electric</b>	
New Solar Hot Water or Heat Recovery System	
Replace T12 Fixtures with T8 LED	NA
Replace T8 Fluorescent Lamps with T8 LED	
Programmable Thermostats for AC	
Roofmount 30-200 KW PV system	
Fix Supply Air Discharge Duct Leaks	
New Lighting Controls	
New VFDs/High Efficiency Booster Pump Motors	
New Heat Recovery/ Desuperheater System	
Insulate Non-insulated Roofs	
Replace AC Systems with High Efficiency Units	
Retrofit with Ultra Low Flow Plumbing Fixtures	
<b>Total Investment (\$M) - Primary ECMs</b>	\$11.1
<b>Simple Payback (years) - Primary ECMs</b>	7
<b>Investment Capitalization (years) - Primary ECMs</b>	10
<b>Dollar Savings (millions per year) - Primary ECMs</b>	\$1.5
<b>Percent Reduction in Utility Costs - Primary ECMs</b>	62%
<b>Total Investment (\$M) – All Feasible ECMs</b>	\$23.7
<b>Simple Payback (years) – All Feasible ECMs</b>	13
<b>Investment Capitalization (years) – All Feasible ECMs</b>	13
<b>Dollar Savings (millions per year) - All Feasible ECMs</b>	\$1.8
<b>Percent Reduction in Utility Costs - All Feasible ECMs</b>	71%
ECM Recommended – Primary Recommendation	
ECM Recommended– Other, feasible if funding permits	
Not proposed	

The updated analysis, which includes the retrofit of the recently installed T-8 with LED linear lamps for an additional 30% improvement in energy efficiency for lighting, suggests that the implementation of the Primary ECM's will still be cost effective, with the total annual savings for all Primary ECM's totaling \$1.5 Million at a total investment cost of \$11.1 Million. The total annual savings including all additional feasible ECM's, including replacement of all of the air conditioning equipment with high efficiency units, and the replacement of all plumbing fixtures with low flow plumbing fixtures, would increase to \$1.8 Million at a total investment cost of \$23.7 Million. The implementation of these additional feasible ECM's would also have a significant positive impact on addressing the Deferred Maintenance (DM) for the replacement and maintenance on these items.

In addition to ECMs, Mariana High School had a project to construct a new 160 kW roof mounted photovoltaic system. This project was funded by OIA and assisted by the National Renewable Energy Lab (NREL).

## VI. RECOMMENDATIONS

Following are descriptions of Mechanical / Electrical / Plumbing (MEP) Health and Safety Issues of prominent concern, as well as some other common repair issues, along with recommended repair solutions.

These recommended projects are provided as a means to assist in accelerating the time to complete these types of projects by providing identification of prominent issues as well as suggested solutions.

### 1) HVAC System

#### a) Air conditioning equipment:

CNMI PSS uses unitary air conditioning systems including ductless split, ducted split and packaged air conditioners in their facilities. PSS has an energy conservation program in place stipulating that air conditioning equipment be operated only four hours per day during midday hours and be turned off on weekends and holidays. When air conditioners are installed or replaced, the following recommendations should be considered:

- EPA approved refrigerant, high efficiency system and corrosion protective coating air conditioning equipment should be used.
- Placement of condensing units should consider maintenance accessibility, required operation clearance, and acoustical impact to classrooms; minimize penetrations to building envelopes; and typhoon protection.
- Metal supports with corrosion protective coating should be used when AC equipment is supported off the ground.
- Provide typhoon tie downs and seismic restraints.
- Remove old air conditioning equipment and seal all unused penetrations.

#### b) Indoor air quality:

Ventilation should conform to ASHRAE 62.1. Space comfort level should conform to ASHRAE 55.1. HVAC system deficiencies will cause poor indoor air quality, health hazards and damage to building elements and contents.

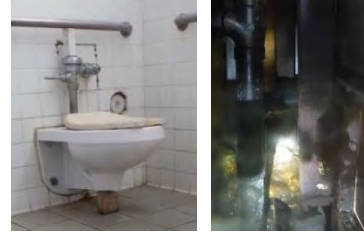
Recommendations:

- Repair air conditioning deficiencies in timely manner. Repair water leaks and condensation as soon as possible.
- Maintain adequate outside air and space comfort levels to the occupied spaces per ASHARE standards.
- Install dehumidifier to classrooms where air conditioning and ventilation will be turned off during the school holidays.
- Provide operable windows for natural ventilation when air conditioning is not needed, or if systems break down.

### 2) Plumbing fixture and piping

Plumbing fixtures and piping should be maintained including supports, pipes and valves. Leaky pipes, defected and loosen fixtures, and clogged waste line should be repaired quickly. Provide ADA fixtures to meet ADA requirements.

Location: Kagman ES, Building 6, restroom – wooden block is used to support water closet. Steel supports for plumbing fixtures inside pipe chase are heavy corroded and broken.



Recommendations:

- Use appropriate material and repair plumbing fixture supports as soon as possible.
- Provide corrosion protective coating to steel plumbing fixture carrier.
- Repair water leak preventing aggravated corrosion damages to plumbing carriers and water damage to building elements.
- Provide access panel to pipe chase and inspect pipe chase regularly.

Location: San Vicente ES, Building 2, Cafeteria – the buried plumbing pipe is too shallow and partially exposed. The pipe could be damaged easily.



Recommendations:

- Provide sufficient bedding material and cover to underground plumbing pipe.

Location: Saipan Southern HS, Building 8, Classroom – The flush valves do not operate properly.



Recommendations:

- Adjust flush valves and water supply pressure for proper flushing operation.

3) Water booster pump

Water booster pump should be installed at proper location and regularly maintained. Booster pumps should be protected from low suction pressure.

Location: Marianas HS Building 19, Gymnasium – Duplex booster pumps are installed at a flooded, below grade pump pit where water leak and seepage from adjacent cistern through pipe penetrations. In addition, booster pumps are frequently burnt out because lacking of low suction pressure protection.



Recommendations:

- Repair water leak to the pump pit.
- Provide low suction pressure protection to booster pump.
- Construct new booster pump room and replace the booster pumps with vertical turbine pumps.

Location: Kagman HS Building 5, Cafeteria and Building 16, Water Tank –

Existing booster pump at Building 5 uses three-phase electrical power supply. This system is not compatible with the emergency power generator from the Emergency Management Office (EMO) when the school is used as a shelter. The existing booster pump is by-passed. Water piping network was modified so that city water feeds to campus directly. Water tank at Building 16 has been overflowing after the piping modification.



Recommendations:

- Replace booster pump with a single phase, 240 Vac booster pump that is compatible with EMO's emergency power generator.
- Install a check valve at booster pump discharge to prevent water from back-feeding into the water tank.
- Troubleshoot and correct the water piping to stop overflow at water tank.



4) Fire pump and fire hose system

Fire pump and fire hose system should be installed and maintained per NFPA 14, NFPA 20 and NFPA 25. System supervision should be installed and maintained per NFPA 72.

Location: Marianas HS Building 19, Gymnasium –

Fire pump is installed at a flooded pump pit. Fire pump and controller are not operable.



Fire protection valve installation supervision was not completed for fire pump control valves.	Fire hose system is deteriorated.
	

Recommendations:

- Provide new fire pump system conforming to NFPA 20 and supervised by fire alarm system.
- Provide new fire hose system conforming to NFPA 14.
- Provide routine testing and maintenance to fire pump system and fire hose system per NFPA 25.



## 5) Fire Alarm Systems

Location: All schools

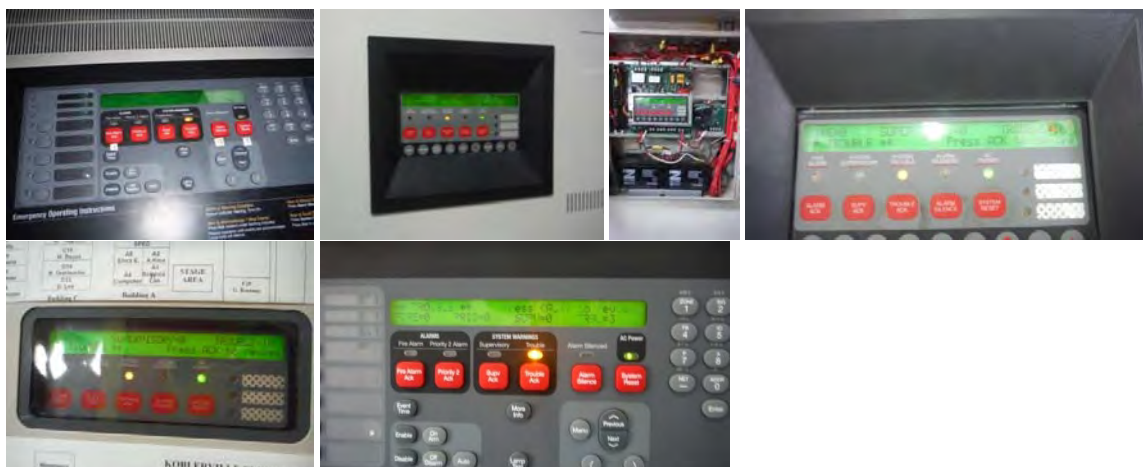
The fire alarm systems are inoperable due to numerous trouble indications, silenced fire alarms and defective devices. There is no regular servicing and testing of fire alarm systems.



Location: Fire alarm panels are inoperable at all OIA III surveyed schools.

Fire alarm panel power is off at Tanapag ES, San Vicente ES, Kagman ES, and Dandan MS.



Fire alarm panels at Marianas HS, Garapan ES, Kagman HS, Hopwood JHS, Koblerville ES, and Saipan Southern HS have trouble indications and silenced alarms.



Obstructed pull station at Garapan ES.	Defected pull station and smoke detector at Hopwood JHS.
	

Recommendations:

- Perform routine maintenance and testing to fire alarm systems per NFPA 72 by qualified technicians. If possible, establish fire alarm technical team within PSS to perform troubleshooting, repair, maintenance and routine testing and certification.
- Repair fire alarm system deficiencies quickly.
- Maintain fire alarm system information, manuals, maintenance and testing records on site.
- Provide regular operation training of fire alarm system to school staffs. Establish fire safety awareness program to promote fire safety awareness to the staffs and occupants.
- Conduct regular tests and fire drills. Coordinate and invite fire department to participate fire test and fire drill.

6) Electrical Lighting Systems

Location: All schools

Lighting fixtures should be maintained. Defective light bulbs and broken casings should be repaired quickly.

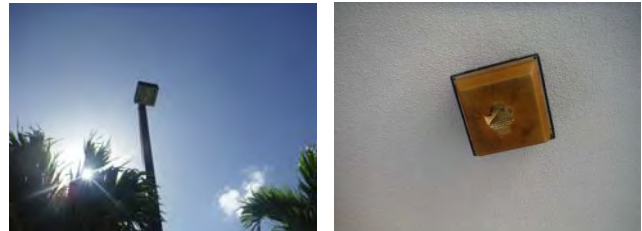
Location: Garapan Elementary School

A column of light bulbs in the cafeteria are burnt out. Some walkway lighting needs bulb replacement or an overall fixture repair.



Location: Kagman Elementary School

Walkway lighting is inoperable. Casing and bulbs are defective. Parking lighting is inoperable due to incorrect bulb retrofitting or a defective circuit.



Exterior/walkway lighting fixtures in Chacha Oceanview Jr. High and Saipan Southern High School are damaged.



Recommendations:

- Defective light bulbs should be replaced with efficient lighting such as T8 fluorescents or CFLs.
- Provide highly durable light casings.

## 7) Electrical Power System

Power systems which include electrical conduits, wiring, panel boards, and receptacle outlets should be installed and maintained in accordance with the National Electrical Code.

Location: Hopwood Jr. High School

Exterior receptacles are not GFCI and were installed without a weatherproof cover outside Main Building 03. Two exterior receptacles on the side of building C are not GFCI and were installed without a weatherproof cover. Water fountain receptacle on the corridor of building C is not GFCI and has a missing cover.



Exposed wiring on corridor ceiling of Building C. The CUC service line is too low and may be in reach of students.



Location: Saipan Southern High School

Floor and wall receptacles in Room C-106 and other buildings are damaged by flooding and in-wall moisture.



Meter enclosure outside of PE building has degraded. Panel Board enclosure is missing spare breaker covers and does not fully cover the main breaker.



Location: San Vicente Elementary School

Service disconnect switch is padlocked in the closed position.



Location: Kagman Elementary School

A temporary exposed power line supplying the stage has not been removed.



Recommendations:

- Provide GFCI receptacles with weatherproof covers for all exterior, weather exposed outlets.
- Replace all degraded/rusted electrical enclosures.
- Remove unused exposed wiring.

STRUCTURAL SUMMARY REPORT  
COMMONWEALTH OF THE NORTHERN MARIANA  
ISLANDS  
October 2015

Prepared by:  
Martin & Chock, Inc.



## I. Prioritization of Structural Repairs Prior to the Phase III Site Visits

A initial list for prioritization of repair projects was compiled based on the ratings of the Phase II building assessments. The Phase II Assessments entailed rapid observations of damage to non-concealed structural elements. At the top of the list are all buildings with structural damage identified as a life safety issue. Table 1 below provides a summary of all building damage identified to present a life safety concern prior to the Phase III site visits. Table 2 considers the next priority items with Conditions 0, 1 and 2 ratings prior to the Phase III. Table 3 considers the next level of priority items with Condition 3 ratings.

**Table 1 – Summary of Buildings with Structural Life Safety Concerns Prior to the Phase III Site Visits**

	SCHOOL	BUILDING ID / DESCRIPTION	ELEMENT
SAIPAN	Hopwood Jr High School	23-Pavillion	Wood bearing walls
	Koblerville Elementary School	13-Covered Walkways	Wood/Flat or Pitched
	Marianas High School	04-D	CIP Beam & Slab
		06-E	CIP Beam & Slab
		16-T south	CIP Beam & Slab - Roof
			Steel Columns
			Steel Frames
	San Vincente Elementary School	04-A	CIP Beam & Slab
ROTA	Rota Jr./Sr. High School	08-Mech. Shop.	CIP Beam & Slab - Roof

**Table 2 – Summary of Condition 0, 1 and 2 Items Prior to the Phase III Site Visits**

	SCHOOL	BUILDING ID / DESCRIPTION	LIFE SAFETY ELEMENT
SAIPAN	G.T. Camacho Elementary School	05-4 Maint.	Wood/Flat or Pitched
	Garapan Elementary School	11-Maintenance	Slab on Grade
			Wood Roof Decking
			Wood/Flat or Pitched
	Hopwood Jr High School	02-A	Wood/Flat or Pitched
	Oleai Elementary School	11-G	Wood/Flat or Pitched
		12-Bus Shelter	Wood/Flat or Pitched
	Reyes Elementary School	17-Canteen	Wood bearing walls
	Tanapag Elementary School	09-I	Reinforced Masonry bearing walls
TINIAN	Tinian Elementary School	06-Condemmed Classroom	Wood/Flat or Pitched
		13-Shower - K	Concrete Structural Bearing walls
			Wood/Flat or Pitched

**Table 3 – Summary of Condition 3 Items Prior to the Phase III Site Visits**

	SCHOOL	BUILDING ID / DESCRIPTION	LIFE SAFETY ELEMENT
SAIPAN	<b>Dandan Elementary School</b>	11-Maintenance	Wood/Flat or Pitched
	<b>G.T. Camacho Elementary School</b>	01-1A library 03-3C Cafeteria 04-RR 06-E Admin	Wood Roof Decking Wood Roof Decking Wood Roof Decking Wood/Flat or Pitched Wood/Flat or Pitched
	<b>Garapan Elementary School</b>	10-SPED  13-RR1 15-Covered Walkways	CIP Beam & Slab CIP Beam & Slab - Roof CIP Column - Floor Wood/Flat or Pitched Wood/Flat or Pitched
	<b>Hopwood Jr High School</b>	06-C 12-E2  15-Voc  17-LMA	Wood/Flat or Pitched CIP Column - Floor Steel Joists, Beams & Deck on Columns & Walls Steel Joists, Beams & Deck on Columns & Walls
	<b>Marianas High School</b>	12-M  14-T north  17-alternative 20-bus stop 21-store	CIP Beam & Slab - Roof Steel Joists, Beams & Deck on Columns & Walls Steel Joists, Beams & Deck on Columns & Walls Slab on Grade Spread Footing
	<b>Oleai Elementary School</b>	01-B 03-D 04-A Admin 05-B-RR 07-Cafeteria	Wood Roof Decking Wood Roof Decking Steel Canopy Wood Roof Decking CIP Column - Floor
	<b>Reyes Elementary School</b>	05-E 12-Maintenance  17-Canteen	CIP Column - Floor Steel Columns Steel frame or braced frames Wood/Flat or Pitched
	<b>San Antonio Elementary School</b>	01-A	CIP Column - Floor
	<b>San Vicente Elementary School</b>	10-K 19-Covered Walkways	CIP Column - Floor Wood/Flat or Pitched
	<b>Tanapag Elementary School</b>	04-A  09-I  14-Stage	Slab on Grade Spread Footing Strip Footing Slab on Grade Strip Footing Slab on Grade

TINIAN	Tinian Elementary School	01-B	CIP Beam & Slab - Roof
			CIP Column - Floor
		03-I	CIP Beam & Slab - Roof
		06-Condemmed Classroom	Slab on Grade
		09-RR - E	Reinforced Masonry bearing walls
			Slab on Grade
		12-Restroom - K	Concrete Structural Bearing walls
ROTA	Rota High School	13-Shower - K	Slab on Grade
		15-Restroom - B	Wood/Flat or Pitched
	Rota Jr./Sr. High School	03-D	Concrete Structural Bearing walls
		08-Mech. Shop.	Reinforced Masonry bearing walls
		10-Dugout R.F.	Slab Only -Roof
			Steel Columns

## **II. Phase III Site Visits**

The purpose of the Phase III site visits was to:

- Get input from the stakeholders in the Territory
- Evaluate new life safety issues that were not previously identified or conditions that were identified but need to be elevated to a higher priority.
- Determine if the high priority conditions at the schools identified during Phase II have changed appreciably.
- Outline a scope of work for the high priority structural items.

Based on the prioritization exercise performed by our office and input from stakeholders in the Territory, the following school buildings were re-visited during our April 2015 visit to all school districts on the island of Saipan:

Tuesday, April 21, 2015 (Central and South)

1. Marianas High School
2. Oleai Elementary School
3. San Vicente Elementary School
4. Saipan Southern High School
5. Koblerville Elementary School

Wednesday, April 22, 2015 (North and Central)

1. Reyes Elementary School
2. Hopwood Junior High School
3. GT Camacho Elementary School
4. Tanapag Middle School
5. Garapan Elementary School

Thursday, April 23, 2015 (East)

1. Chacha Middle School
2. Kagman High School
3. Kagman Elementary School

Thursday, April 24, 2015 (South)

1. San Antonio Elementary School

Note that most of the high priority structural items listed in Tables 1 through 3 are located on the Island of Saipan, and those that are located at schools on Tinian and Rota are generally abandoned structures or minor structures with well know condition based on the Phase II assessments. Therefore the focus of the Phase III site visits was at schools on Saipan, although the schools on the other islands remain at the appropriate priority levels.



### **III. General Observations and Additional Findings during the Phase III Site Visits**

Structural health and safety items had been addressed with the concrete spalling in two buildings at Marianas High School. Other health and safety issues remained. One new safety concern was observed at Hopwood Junior High School, where the exterior awning at the ocean side of the VOC building has partly collapsed and has the potential for future collapse. The awning should be at least temporarily removed. Another safety concern at this school was the lack of support for the roof at the walkway between the two wings of Building C. The deterioration and potential for falling spalls at Garapan Elementary Building 10 was also identified as an additional safety concern.

Where spall repairs were completed that replaced the concrete through the entire thickness of a concrete slab, beam or wall element, these repairs were generally observed to be effective. Where a surface patch was applied to a concrete member, these repairs appeared to be less effective, with some patches having cracks or starting to delaminate. The preparation and materials used in these types of repairs is critical to the effectiveness of the repairs.

Exposed structural steel, corrugated metal roofing or exposed steel beams, is observed to deteriorate rapidly if left unprotected. The zinc coating on corrugated roofing will provide some galvanic protection, but will be used up quite rapidly in exposed conditions. A program where a sound coating is maintained at all of these types of conditions will significantly increase the life of these components.

Termite damage appears to be quite widespread in a number of schools particularly the coastal schools such as Hopwood Junior High and San Antonio Elementary. Some termite abatement is understood to be ongoing. Other options for termite abatement such as tenting of buildings could be considered to eliminate active but concealed termites from some buildings, along with an ongoing maintenance program.

The following narrative provides a detailed discussion of the findings at each of the buildings that were visited during the Phase III site visits. New life safety items are noted and described.

### **1A. Marianas High School – Building D**

Repairs to the slab soffits through the full thickness of the slabs have been completed. Some soffit surface spall repairs have also been completed but appear to have some shrinkage cracking and potential for delamination. It is probably that there was too much water in the repair mortar. The use of a specifically formulated latex modified patch repair mortar may improve the performance of future similar repairs. The repair areas should also be undercut to create clean edges, rather than feathering the patch material to zero thickness.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



### **1B. Marianas High School – Building E**

Repairs to the slab soffits through the full thickness of the slabs have been completed. There are some beam spalls that were not repaired. They have at least been painted to reduce the impact of reinforcing corrosion.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



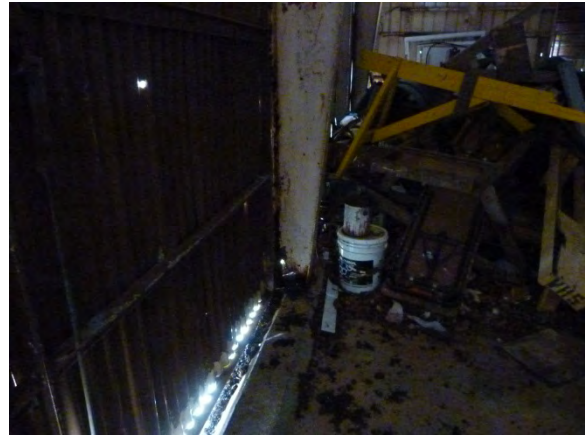
### **1C. Marianas High School – Building T - Maintenance Shed**

The extensive corrosion at the column bases remains. This remains a life safety issue as several of these columns are potentially unstable.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



## **2A. Oleai Elementary School – Bus Shelter**

The bus shelter has been partly demolished to remove the long span sagging roof framing that was previously observed. A new bus shelter structure has been proposed that will replace the existing structure. This needs to be designed meet the current building code for wind and other loading.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



## **2B. Oleai Elementary School – Building G**

The roof of Building G adjacent to the cafeteria still has visible signs of termite damage and is sagging due to its long span. It needs repair or replacement.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)





### **3A. San Vicente Elementary School – Building A (Ramp and Stairs)**

Building A has a steel framed access ramp that was observed to be corroded and potentially inadequately supported with damage to the joints between the steel support girder segments. The ramp has been painted to provide some protection and appears to have had some modifications to divert drainage around the ramp. The adequacy of the supports for the ramp is still questionable. It is recommended that an additional support be provided under the span between the building and the current column support.

The stairs at the other end of the building were corroded at the treads. An additional concrete topping was added to protect the treads. Although this has resulted in uneven stair riser heights at the top and bottom of the stair that do not meet typical building code requirements, due to the potential trip hazard associated with stairs having inconsistent riser heights.

Phase II Site Visit (October 2012)



Phase III Site Visit (April 2015)





**3B. San Vicente Elementary School – Building K**

Spalling around the base of a number of the columns in this building remains.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



### 3C. San Vicente Elementary School – Covered Walkways

Portions of the covered walkways were blown down during a recent tropical storm and have subsequently been removed. These are yet to be rebuilt but have eliminated most areas of roof with severe termite damage. There is some termite damage that remains. These areas of the covered walkway roofs should be replaced. Plywood has been used for the fascia of some of the covered walkways, and other buildings, which is severely degraded. It should be removed and replaced.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



#### **4. Saipan Southern High School**

There are currently no significant high priority structural issues or changes to structural conditions. There is notable non-structural deterioration since the previous trip. Items such as missing or deteriorated gutters, window leaks and site drainage issues will lead to more serious structural issues if not addressed.

## **5A Koblerville Elementary School – Maintenance Shed**

Part of the maintenance shed roof was damaged during a recent tropical storm and is yet to be repaired.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)





## 5B Koblerville Elementary School – Covered Walkways

A segment of the covered walkways has quite severe termite damage. This was considered a safety hazard in Phase II and remains as such. Another section, which is understood to have been added quite recently, is in good condition by missing a vertical web member in the roof trusses. Other segments have no bottom chords in the trusses. These have limited strength and are vulnerable to a tropical storm.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)





#### **6A Reyes Elementary School – Buildings D, D2, E and F**

These buildings are of a common construction type. Their original roofing was reported to be cedar shingles over the wood tongue and groove decking. It is understood that when the shingles were replaced, not all the nails were completely removed. When they placed the new waterproof membrane over the decking and under the metal roofing it was penetrated by the nail heads. As a result these buildings have leaks in a number of locations. Any reroofing project, for these buildings and other similar buildings, needs to remove these nails and provide a smooth substrate for a new waterproofing membrane and roofing.

Spalling at the base of the columns remains, primarily on the west side of Building E.

##### Phase II Site Visit (September 2012)



#### **6B Reyes Elementary School – Cafeteria Building A**

The cafeteria has a flat roof with a parapet and internal drains. Blockage of the drains and other problems persist, first observed at the Phase II site visit. There are leaks around the drains at a number of locations. It has not yet resulted in significant structural damage, but will lead to deterioration.

##### Phase II Site Visit (September 2012)



##### Phase III Site Visit (April 2015)



## 6C Reyes Elementary School – Maintenance Building

This structure is in poor condition. It is probably best to demolish the building. The Principal mentioned that it may be converted to a parking area. It may be preferable to construct a much smaller maintenance building elsewhere, not at the main frontage of the school.

If the building is to be reused, it needs to be completely re-roofed and new siding installed. The interior ceiling has mostly already been removed. The structural framing is in poor condition in isolated locations and fair condition elsewhere. For reuse it needs to have localized framing repairs and all the steel recoated.

### Phase II Site Visit (September 2012)



### Phase III Site Visit (April 2015)



#### **6D Reyes Elementary School – Canteen**

The canteen is a small building, but extensively termite damaged and has deteriorated further since the Phase II assessment. It would be best to demolish and rebuild the structure, salvaging and reusing the any equipment and the slab-on-grade.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



### **7A Hopwood Junior High School – Building A**

Extensive termite damage in the wood partition walls and roof framing was observed in Building A. It is not clear whether or not this termite activity is ongoing or has just occurred in the past. It is understood that termite abatement is ongoing with regularly scheduled ground treatments; however it may be that termite activity already in the building has not been completely abated. It is advised to consider termite tenting of this building so that any remaining activity is arrested. It is understood that the capacity for tenting is not currently available in the territory, but the capacity exists in Hawaii and other states. Alternatively, a thorough termite inspection and chemical spot treatment should be completed along with structural repairs.

Phase II Site Visit (September 2012)



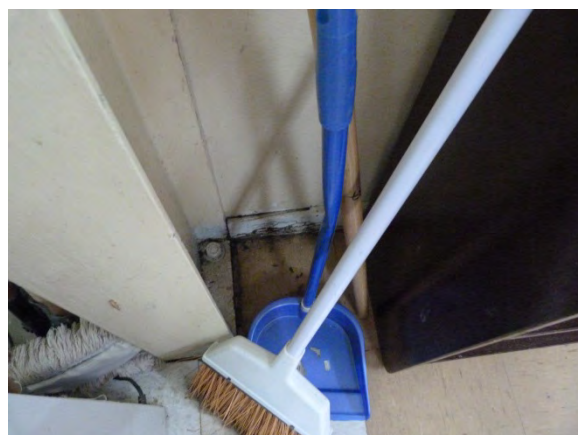
Phase III Site Visit (April 2015)



### **7B Hopwood Junior High School – Building B2**

The teachers were reporting termite activity in the cabinets and furniture of Building B2. The teacher had used a Bonide termiticide to kill the termites. There is a concern that the termiticide is not for interior use, according to manufacturer's instructions. Therefore this type of treatment should be discouraged and professional treatment provided. This building would also be a candidate for termite tenting or abatement.

Phase III Site Visit (April 2015)





### **7C Hopwood Junior High School – Buildings C**

The section of roof in the pass-through between the two wings of the building was observed to be sagging. This is attributed to having no substantial beam supporting the roof trusses and rafters, just a flatwise oriented 2 inch deep wood member. In building A, wood beams have been added on either side of the building between the two wings to support a similar section of roof. Similar beams are needed in this building. The sagging may have been worsened by degradation from roof leaks. This is flagged as a safety hazard due to the potential for collapse of the roof in this area with further deterioration or overload.

Termite damage was also observed in at least one wood partition wall between two classrooms in this building.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)





### **7D Hopwood Junior High School – Music Room**

A section of roof at this building was torn off during a recent tropical storm. This has resulted in water freely flowing into the building. This needs to be at least temporarily patched to prevent water flowing into the building and ultimately shall be reroofed. It is currently abandoned. In its current condition open to the elements it will deteriorate rapidly and will soon be not salvageable.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



### **7E Hopwood Junior High School – LMA and VOC**

Both buildings have severe deterioration of the exposed steel that supports the exterior awnings. One segment of awning in the VOC building was damaged during a recent tropical storm. This segment needs to be immediately removed as it is likely to collapse and is a safety concern. Ultimately it is recommended that all of the awnings be removed. The interior steel framing condition, where not exposed to the weather, is significantly better.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



### **7F Hopwood Junior High School – Pavilion**

During the Phase II site visit this structure was a safety concern due to the lack of support for parts of the roof in this pavilion, where sections of walls in the original structure have been removed. This concern has not yet been addressed. The concern is at the side walls, those walls perpendicular to the face shown in the photos, as these walls support the roof trusses. There are no headers at the wall openings.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



## **7H Hopwood Junior High School – Palapala Restroom and Attached Awning**

During the Phase II site visit it was observed that the roof framing for the awnings was added to the eave extensions for the roof trusses of the adjacent restroom. The awning roof framing had a very long span for the size and the rafters with joints sistered near their midspan. These rafters had very limited structural capacity to support the roof. During the Phase III site visit it was observed that an additional beam and row of posts was added to help support the end of the rafters adjacent to the restroom. This reduces the stresses on the restroom roof framing and helps to increase the strength of the roof framing, but it would still be best to reduce the long span of the discontinuous rafters or reframe and reroof the awning.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)





### **8A GT Camacho Elementary School – Building D**

The hole in the cladding at the gable end has increased in size since the previous site visit. This is a source of moisture into the building and will start to damage the framing, ceiling and walls.

Phase II Site Visit (August 2012)



Phase III Site Visit (April 2015)



### **8B GT Camacho Elementary School – Restroom**

There is new damage to the restroom siding that was not evident during the Phase II site visit. There is exposed reinforcing and spalling at the top of one of the columns.

Phase II Site Visit (August 2012)



Phase III Site Visit (April 2015)



### **9A Tanapag Middle School – Restroom (formerly used for Storage)**

The major spalls around the columns and walls at this restroom have been repaired and the restroom has generally been renovated since the Phase II site visit. Small cracks and spalls remain. While, they are not significant structurally, these are a source of moisture and future deterioration. It is recommended that when a building such as this is renovated the smaller cracks and spalls are also repaired, or at least sealed and painted.

Phase II Site Visit (August 2012)



Phase III Site Visit (April 2015)





### **9B Tanapag Middle School – Stage**

The stage is aesthetically in poor condition with missing cladding at the gable end. Structurally the roof framing appeared to be in good condition during the Phase II site visit. It is underutilized as the area in front of the stage suffers from poor drainage, therefore can only be used after dry periods of weather.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



### **9C Tanapag Middle School – Building J**

This building was undergoing renovation during the Phase III site visit.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



### **10A Garapan Elementary School – Title 1/Bilingual Building (Former SPED)**

This building has undergone a minor interior renovation, but still has a number of spalls and exposed reinforcing around the exterior. These have worsened since the Phase II site visit. Some delaminations are potential falling hazards; therefore, the building has been identified as a potential safety hazard.

Phase II Site Visit (August 2012)



Phase III Site Visit (April 2015)



### **10B Garapan Elementary School – Covered Walkway**

One section of covered walkway is largely unsupported where it adjoins Building A. An additional support is needed.

Phase II Site Visit (August 2012)



Phase III Site Visit (April 2015)





### **11A Chacha Middle School – Library Building**

Leaks in library remain at the low point of the roof where there is an internal drain and parapet wall. Leaks also remain at some of the windows. These are not significant structural issues at this point, but will become structural issues with further moisture infiltration.

Phase II Site Visit (August 2012)



Phase III Site Visit (April 2015)



### **11A Chacha Middle School – Covered Walkway Joint**

The joint between the library building and Building B does not appear to provide adequate vertical support at the end of the slab. The slab is visibly sagging already and there is a notable vertical offset between the slabs on the two sides of the joint. This warrants further investigation and possible retrofit as it may be a structural safety hazard.

Phase II Site Visit (August 2012)



Phase III Site Visit (April 2015)



**12A Kagman High School**

There are currently no significant structural issues. Roof coatings are failing that could lead to structural issues if not maintained.

**13A Kagman Elementary School**

There were no significant changes to structural conditions observed.



#### **14A San Antonio Middle School – Covered Walkways**

There is significant termite damage at some of the wood framed covered walkways and the awning in front of the main office. The condition appears to be similar to that previously observed in Phase II, therefore the termite mitigation may have at least arrested further deterioration. Repairs are necessary as the structural integrity of several framing members has been severely compromised.

Phase II Site Visit (September 2012)



Phase III Site Visit (April 2015)



#### IV. Prioritization of Structural Repairs After the Phase III Site Visits

The original priority tables are reproduced with changes between the Phase II and Phase III condition assessments provided. Table 4 below provides a summary of all building damage identified as a life safety concern following the Phase III site visits. Three new structural safety hazards have been identified, including: the lack of beams supporting the roof between the two wings of Building C and the damaged awning in the VOC building at Hopwood Junior High School, and the deterioration and potential of spalls of Building 10 (Title 1/ Bilingual) at Garapan Elementary School. The soffit spalls that were a hazard at Marianas High School have been removed for the priority list.

Table 5 summarized the Condition 0,1 and 2 Items that remain after the Phase III site visits, excluding those items on the Life Safety list of Table 4. Table 6 summarizes the Condition 3 items. It was not the intent of the Phase III site visits to resurvey the schools, but where a change in conditions was observed, these items have been reflected in the updated tables. There are some deleted items and some new items, though it is noted that most conditions in the territory have not changed.

**Table 4 – Summary of Life Safety Items After the Phase III Site Visits**

	SCHOOL	BUILDING ID / DESCRIPTION	LIFE SAFETY ELEMENT
SAIPAN	<i>Garapan Elementary School</i>	<i>10-Title 1/Bilingual (Former SPED)</i>	<i>CIP Beam &amp; Slab</i>
	Hopwood Jr High School	06-C	Wood/Flat or Pitched
		15-VOC	Steel Joists, Beams & Deck
		23-Pavillion	Wood bearing walls
	Koblerville Elementary School	13-Covered Walkways	Wood/Flat or Pitched
	Marianas High School	<del>04-D</del>	<del>CIP Beam &amp; Slab</del>
		<del>06-E</del>	<del>CIP Beam &amp; Slab</del>
			<del>CIP Beam &amp; Slab - Roof</del>
		16-T south	Steel Columns Steel Frames
	San Vicente Elementary School	04-A	CIP Beam & Slab
ROTA	Rota Jr./Sr. High School	08-Mech. Shop.	CIP Beam & Slab - Roof

**Table 5 – Summary of Condition 0, 1 and 2 Items After the Phase III Site Visits**

	SCHOOL	BUILDING ID / DESCRIPTION	LIFE SAFETY ELEMENT
SAIPAN	G.T. Camacho Elementary School	05-4 Maint.	Wood/Flat or Pitched
	Garapan Elementary School	11-Maintenance	Slab on Grade Wood Roof Decking Wood/Flat or Pitched
	Hopwood Jr High School	02-A	Wood/Flat or Pitched
		07-Music	Wood/Flat or Pitched
	Oleai Elementary School	11-G	Wood/Flat or Pitched
		12-Bus Shelter	Wood/Flat or Pitched
	Reyes Elementary School	<b>12-Maintenance</b>	<b>Steel frame or braced frames</b>
		17-Canteen	Wood bearing walls
	<del>Tanapag Elementary School</del>	<del>09-1</del>	<del>Reinforced Masonry bearing walls</del>
TINIAN	Tinian Elementary School	06-Condemmed Classroom	Wood/Flat or Pitched
		13-Shower - K	Concrete Structural Bearing walls Wood/Flat or Pitched

**Table 6 – Summary of Condition 3 Items After the Phase III Site Visits**

	SCHOOL	BUILDING ID / DESCRIPTION	ELEMENT
SAIPAN	<i>Chacha Oceanview Jr High School</i>	<i>02-Admin/Library</i>	<i>Steel Joists and Composite Slab</i>
	Dandan Elementary School	11-Maintenance	Wood/Flat or Pitched
	G.T. Camacho Elementary School	01-1A library 03-3C Cafeteria 04-RR  06-E Admin <b>07-6 D</b>	Wood Roof Decking Wood Roof Decking <b>Reinforced Masonry bearing walls</b> Wood Roof Decking Wood/Flat or Pitched Wood/Flat or Pitched <b>Reinforced Masonry bearing walls</b>
	Garapan Elementary School	10 – Title1/Bilingual (former SPED)  13-RR1 15-Covered Walkways	CIP Beam & Slab  CIP Beam & Slab - Roof CIP Column - Floor Wood/Flat or Pitched Wood/Flat or Pitched
	Hopwood Jr High School	<del>06-C</del> <b>10-RR</b> 12-E2 <del>15-Voc</del> 17-LMA	<del>Wood/Flat or Pitched</del> <b>Wood/Flat or Pitched</b> CIP Column - Floor <del>Steel Joists, Beams &amp; Deck on Columns &amp; Walls</del> Steel Joists, Beams & Deck on Columns & Walls
	<i>Koblerville Elementary School</i>	<i>12-Maintenance</i>	<i>Wood/Flat or Pitched</i>
	Marianas High School	<b>01-A</b> <b>06-E</b> 12-M 14-T north 17-alternative 20-bus stop 21-store	<b>Slab on Grade</b> <b>CIP Beam &amp; Slab</b> CIP Beam & Slab - Roof Steel Joists, Beams & Deck on Columns & Walls Steel Joists, Beams & Deck on Columns & Walls Slab on Grade Spread Footing

	<b>Oleai Elementary School</b>	01-B 03-D 04-A Admin 05-B-RR 07-Cafeteria	Wood Roof Decking Wood Roof Decking Steel Canopy Wood Roof Decking CIP Column - Floor
	<b>Reyes Elementary School</b>	05-E 12-Maintenance 17-Canteen	CIP Column - Floor Steel Columns <del>Steel frame or braced frames</del> Wood/Flat or Pitched
	<b>San Antonio Elementary School</b>	01-A	CIP Column - Floor
	<b>San Vicente Elementary School</b>	10-K 19-Covered Walkways	CIP Column - Floor Wood/Flat or Pitched
	<b>Tanapag Elementary School</b>	04-A  09-I  14-Stage	Slab on Grade Spread Footing Strip Footing Slab on Grade Strip Footing Slab on Grade
<b>TINIAN</b>	<b>Tinian Elementary School</b>	01-B  03-I 06-Condemed Classroom 09-RR - E  12-Restroom - K 13-Shower - K 15-Restroom - B	CIP Beam & Slab - Roof CIP Column - Floor CIP Beam & Slab - Roof Slab on Grade Reinforced Masonry bearing walls Slab on Grade Concrete Structural Bearing walls Slab on Grade Wood/Flat or Pitched
<b>ROTA</b>	<b>Rota High School</b>	03-D	Concrete Structural Bearing walls
	<b>Rota Jr./Sr. High School</b>	08-Mech. Shop. 10-Dugout R.F.	Reinforced Masonry bearing walls Slab Only -Roof Steel Columns



#### **IV. Recommended Scope of Work for the High Priority Structural Items**

A description of recommended repair procedures and an outline of structural scope of work is provided for each of the remaining high priority structural repair projects with healthy and safety concerns or Conditions 1 and 2 items. For a description of existing conditions and photographic exhibits, refer to Section III of this report.

Recommended general repair procedures, for repetitive structural repairs of cracks, spalls and light framed covered walkways, are provided see Appendices A-C respectively. For the crack repairs a flexible sealant is recommended on the basis that the cracks are not as a result of a structural overstress situation. A structural engineer shall be consulted if there is a potential that such a condition exists. The area around a crack should be sounded with a hammer to determine if there is a delamination, that may not be immediately obvious. If this type of condition exists it should be treated as a spall repair. The spall repair recommendations show typical conditions in slab, columns, beams and walls. These repair procedures provide the proper preparation and undercut of the surface of the existing concrete, and material recommendations, to achieve a durable patch. Typical covered walkway repairs are also recommended.

Repair procedures are not listed for structural items associated with Condition 3 assessments. These may be completed using the general repair procedures provided in the appendices where applicable. Where a specific scope is needed, these will need to be developed if and when they get elevated to the priority repair items.

The summaries are provided as a tool to assist the Public School System staff in determining scope, cost, and schedule when preparing requests for proposals for the design and execution of repair work.

#### **Structural Health and Safety Items**

##### **1. Garapan Elementary School – 10 – Title 1/Bilingual Classrooms**

Survey and repair the spalls to columns, slab soffits and walls, following the procedure provided in Appendix B.

##### **2. Hopwood Jr High School – 06 – Building C**

Consult with a structural engineer to design new wood beams to span across the gap between the two wings of the building and support the roof framing. Provide design and construction documentation for the connection details. Install the new beams per these construction documents.

##### **3. Hopwood Jr High School – 15 – VOC**

Remove the partly collapsed section of awning before it falls. Provide additional flashing at the siding to ensure that the removed awning does not cause water infiltration into the building.

A plan for the future use of this building and Building 16 – LMA needs to be developed. The Principal expressed a possible desire to remove the entire wall siding and interiors from the building and convert them to large open recreational spaces. This may be an appropriate use of one or both buildings. In this case the existing awning framing shall be removed and the remaining framing coated with a high performance coating system to prevent future deterioration in the would be exposed environment.

Another type of renovation may be preferred. If not demolished, the awnings need to be completely replaced and protected from future deterioration.

#### **4. Hopwood Jr High School – 23 – Pavilion**

Consult with a structural engineer to design continuous beams that span between the wall segments to support the roof trusses, on either side of the roof. Remove the wall siding and modify the wall framing as required in order to install the beams and repair the wall framing. Reinstall the wall siding.

#### **5. Koblerville Elementary School – 13 – Covered Walkways**

Replace the termite damage sections of the covered walkways following the guidelines in Appendix C. Install bottom chord framing and vertical web members where these are missing to increase the resilience of these covered walkways during an extreme wind event.

#### **6. Mariana High School – 16 – Building T, Maintenance**

Have a structural engineer perform a survey of all the steel framing in the building to identify all areas that have deterioration exceeding a threshold that is determined to be unacceptable, for example 10% of loss of the steel cross section. Design and prepare construction documentation for repairs where necessary. It is recommended to encapsulate the base of all columns including the deteriorated columns with a reinforced concrete pedestal to prevent further deterioration. Coat the base of the pedestal with a waterproof bitumastic, or other, coating to prevent moisture infiltration. Clean and recoat all the steel framing with a durable coating system, such as one with a zinc based primer and epoxy finish coating. Replace siding and roofing as required.

#### **7. San Vicente Elementary School – 04 – Building A**

It is recommended to install an additional vertical support to reduce the span of the ramp support girders and the stresses in the deteriorated joints of the girders. Install a vertical support downslope of the current support in a similar configuration with a concrete footing base. Consult with a structural engineer to design the vertical support, foundation and verify the capacity of the existing ramp support girders. Clean and recoat all the steel framing of with a durable coating system, such as one with a zinc based primer and epoxy finish coating.

#### **8. Rota Junior/Senior High School – 08 – Mechanical Shop**

It is recommended to demolish this building as a repair would not be expected to be cost effective due to its poor condition.

### **Condition 1 and 2 Items**

#### **9. G.T. Camacho Elementary School – 05 – Maintenance Building**

Reroof the building in a similar manner to typical covered walkways, described in Appendix C.

#### **10. Garapan Elementary School – 11 – Maintenance Building**

Reroof the building in a similar manner to typical covered walkways, described in Appendix C. Where framing is inadequate increase the framing sizes. Consult with a structural engineer as necessary.

#### **11. Hopwood Jr. High School – 02 – Building A**

A complete survey of the structural roof framing should be conducted by a structural engineer to identify all the specific areas that have termite damage and to develop repair details for the different conditions. Some replacement of wood members may be necessary. A survey of the wood framed partition walls should also be completed by removing sheathing from one side. It is also recommended that a complete termite abatement be conducted, either by tenting or a systematic localized chemical treatment. Ceiling insulation could be added for energy efficiency.

#### **12. Hopwood Jr. High School – 07 – Music**

This building needs to be completely reroofed. After removal of the existing roof, the framing should first be repaired where water has damaged the framing. After reroofing the interior sheathing should be completely removed to ensure there is no mold due to the excess of moisture in the building. Any wall framing shall be replaced and the interior re-sheathed.

#### **13. Oleai Elementary School – 11 – Building G**

The existing roof structure should be surveyed by a structural engineer. Depending on the condition, the existing structure could be reused with addition rows of beams to reduce the span of the current roof rafters. Alternatively, a new roof structure could be designed and constructed.

#### **14. Oleai Elementary School – 12 – Bus Shelter**

The proposed new bus shelter needs to be designed by a structural engineer for the long roof span. The main span of the existing shelter has been removed, but it would be best to demolish roof structure all the way back to the adjacent cafeteria building. The columns also have some spalls therefore it may be best to demolish these but keep the reinforcing dowels that extend up from the footings for a height of around 3 ft. New 16" square masonry columns could be constructed at relatively low cost.

#### **15. Reyes Elementary School – 12 – Maintenance Building**

It is likely to be most efficient to demolish this building. If it is to be reused then it needs to be stripped down to the bare steel framing and slab. Localized areas where the framing is deteriorated need to be replaced. The steel should be coated with a protective paint system. An architect would be required to design any repurposing of the building to meet the current code requirements.

#### **16. Reyes Elementary School – 17 – Canteen**

It would be best to demolish and rebuild the structure, salvaging and reusing the any equipment and the slab-on-grade. It is anticipated that removal of the siding will uncover extensive termite damage in the framing. If this is not the case, then the framing could be salvaged with repairs where needed. Ties to connect the roof framing to the walls shall be installed. New roofing, siding and doors are required.

#### **17. Tinian Elementary School – 06 – Condemned Classroom**

This structure should be completely demolished. As it has been open for a number of years and has deteriorated, which would make it difficult to reuse if that was ever desired. It will become a hazard if left exposed and not maintained.

#### **18. Tinian Elementary School – 06 – Shower K**

This structure should also be completely demolished if not put back into use.

## **APPENDIX A**

### **RECOMMENDED CONCRETE OR MASONRY CRACK REPAIR PROCEDURE**



### **Existing Conditions:**

Most cracks observed in a concrete or masonry structure are not the result of structural distress that could lead to a structural failure. If there is a potential that cracks are due to structural distress, or due to severe foundation movement (crack widths over 0.060 inches), then a structural engineer should be consulted for an assessment. Most cracks are due to shrinkage in the concrete or masonry or minor movement of foundation elements over time. These cracks are not structurally significant alone, but can lead to deterioration of a structural components and more significant structural consequences if left unchecked.

Concrete directly exposed to water is a porous material and will absorb the moisture. Therefore, roofs or the top of other concrete surfaces exposed to weather should not be relied upon for preventing moisture entering into a building. These surfaces should always have a well maintained waterproof membrane designed to bridge over any cracks in the concrete surface. For other concrete surfaces, such as vertical surfaces where incidental moisture can easily drain away, or the underside of roof eaves, a quality paint coating is generally sufficient to prevent moisture infiltration. The paint can bridge over small cracks in these surfaces and even if not sealed with paint, it has been found that moisture will generally not significantly penetrate through cracks under 0.020 inches in width. For larger cracks moisture can infiltrate through the crack and result in deterioration of the reinforcing and subsequent spalling or mold and other moisture related problems. To prevent these impacts it is recommended that cracks of 0.020 inches or larger be sealed with a non-sag polyurethane or other flexible crack sealant. Epoxy based products should not be used as they do not have the necessary flexibility to accommodate thermal or other movement of the cracks.

### **Recommended Products**

- Quikrete Polyurethane Concrete Crack Sealant
- Sika Sikaflex Concrete Fix or Sikaflex -15 LM
- BASF Sonolastic NP1

### **Recommended Scope of Work and Directions for Repair:**

- 01 Survey the building or buildings to adequately describe the scope of crack repair.
- 02 Prepare the crack to leave it clean, dry, free of oil and other contaminants.
- 03 Cut a V-shape groove along the crack that is around ¼ inch deep and ¼ inch wide.
- 04 Use the nozzle to install sealant into the crack.
- 05 Follow the manufacturer's instructions for other directions and curing.

## **APPENDIX B**

### **RECOMMENDED CONCRETE OR MASONRY CONCRETE OR MASONRY SPALL REPAIR PROCEDURE**

### **Existing Conditions:**

Spalls are pieces of concrete or masonry that have delaminated from the surface of the wall, slab, columns or other structural component. Generally the spall starts when a source of moisture gets into the concrete over a period of time and causes corrosion of the reinforcing. When reinforcing corrodes it expands and the expansive pressure pushes the surface of the concrete loose from the remaining concrete element in the vicinity of the spalls.

Spalls are generally repaired by placing a cementitious patch over the area where the concrete has been damaged. For a spall repair to be effective it must address the cause of the moisture infiltration and prevent further reinforcing corrosion as well as a patch to the concrete. The new concrete patch must be mechanically anchored to the remaining concrete or masonry substrate, by undercutting the existing concrete surface and also using screw anchors where not other reinforcing is present. Where spalls are not yet opened up but there is a crack around the perimeter of a piece of concrete, these areas shall be chipped off and treated like an open spall. If spalls are too widespread then it may be best to demolish the structural component and rebuild it.

Repair details for different conditions are provided in the attached sketches, S-1. These details show repairs for shallow and deep vertical and overhead repairs of columns, beams and walls. They are applicable to concrete or masonry walls.

### **Recommended Scope of Work for Repair:**

- 01 Survey the subject building or buildings to adequately describe the scope of spall repair. Tap on the concrete surfaces of the building with a hammer to identify loose concrete areas that may have started to delaminate due to reinforcing corrosion but may not have yet showed surface signs of deterioration. Remove this loose concrete.
- 02 Select the applicable repair method from Detail 1 or 2 on S-1, depending on the location and depth of each repair.
- 03 Excavate and repair the spall according to the applicable detail. Make sure to complete the undercuts as shown. These are critical to the physical anchorage of the new patch material.
- 04 Replace reinforcing if necessary per Detail 3 on S-1 and install the screw anchors as shown.
- 05 Select applicable products to complete the repair depending on whether the repair is on a horizontal, vertical surface or overhead and depending on the depth of the patch, therefore whether or not it will be formed or trowel applied.
- 06 Complete the repairs per the details and manufacturer's recommended procedures.

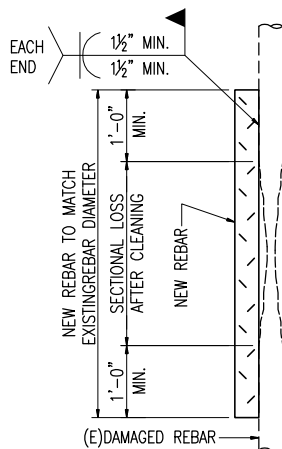
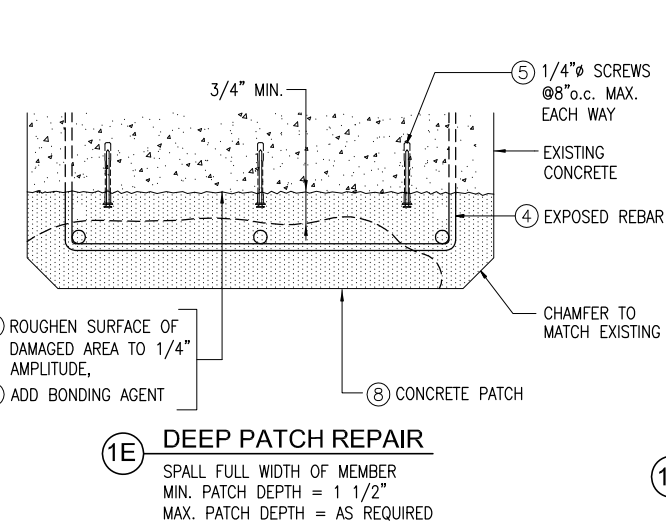
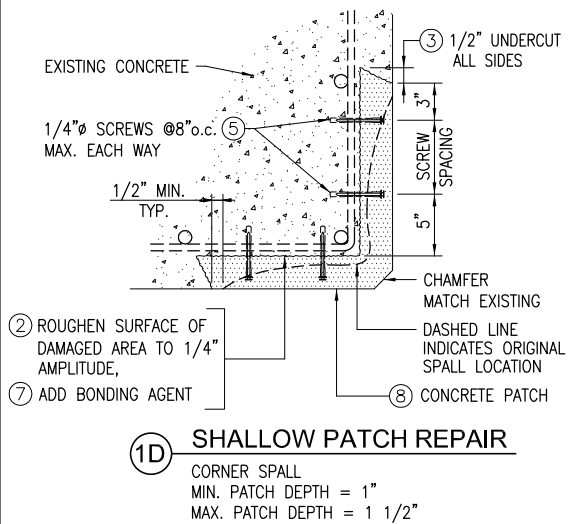
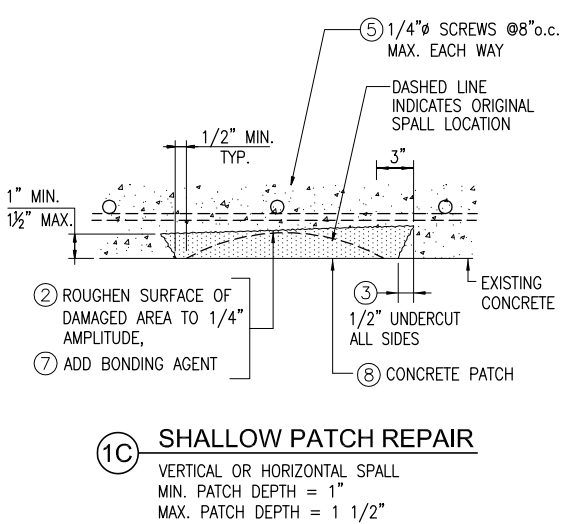
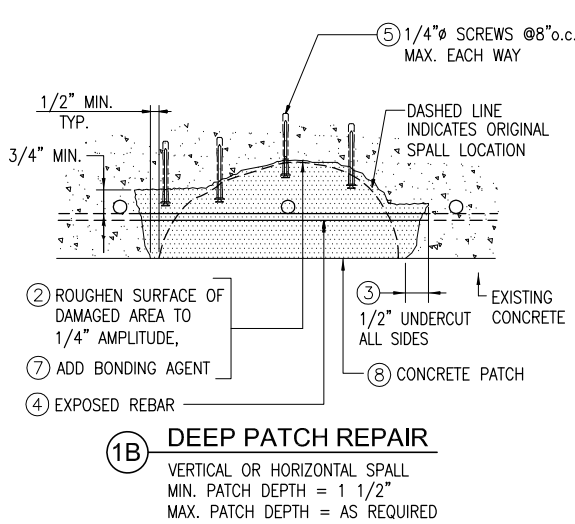
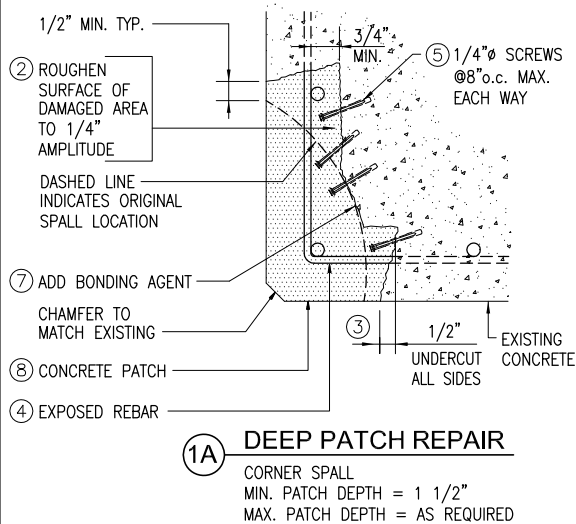
**NOTE: THESE NOTES AND DETAILS ARE A GENERAL RECOMMENDATION ONLY. A LICENSED STRUCTURAL ENGINEER SHALL VERIFY ALL EXISTING CONDITIONS TO DETERMINE THEIR APPLICABILITY.**

**CONCRETE REPAIR NOTES:**

- EXCAVATE ALL LOOSE FRACTURED CONCRETE AROUND SPALL. IN GENERAL, EXTEND LIMITS OF EXCAVATION UNTIL SOUND CONCRETE IS ENCOUNTERED OR AS SHOWN ON THE DRAWINGS. LIMIT CHIPPING GUN TO 15 LB.
- CLEAN ALL EXISTING REBAR OF ALL LOOSE RUST BY SANDBLAST OR NEEDLE GUN.
- ROUGHEN SURFACE TO 1/4" AMPLITUDE AT ALL INTERFACE CONTACT WITH EXISTING CONCRETE SUBSTRATE. PROVIDE UNDERCUT AT PERIMETER OF CONCRETE PATCH AS SHOWN ON DETAILS.
- CLEAN ALL EXCAVATED CONCRETE SURFACES OF DEBRIS, DUST, GREASE, OIL, ETC.
- IN GENERAL, THE FOLLOWING APPLIES TO REPLACEMENT/SUPPLEMENT OF CORRODED REBAR:
  - IF CROSS-SECTIONAL LOSS OF BAR IS LESS THAN 20% AFTER REMOVING ALL CORROSION PRODUCT, THE BAR DOES NOT REQUIRE REPLACEMENT/SUPPLEMENT.
  - IF CROSS-SECTIONAL LOSS OF BAR IS GREATER THAN 20% AFTER REMOVING ALL CORROSION PRODUCT, REPLACE OR SUPPLEMENT WITH SPLICED BARS PER DETAIL 1 THIS SHEET.
- ALL REPLACEMENT REINFORCING STEEL SHALL CONFORM TO ASTM A706 GRADE 60 UNLESS OTHERWISE NOTED.
- WHERE REINFORCING STEEL IS TO BE ADDED, IT SHALL BE LAP SPLICED FOR A LENGTH OF 48 BAR DIAMETERS. IN LIEU OF LAPPED REBAR, NEW REINFORCING MAY BE WELDED TO EXISTING REINFORCING PER DETAIL 1 THIS SHEET.
- PRIOR TO PLACEMENT OF PATCH MATERIAL, THE EXPOSED CONCRETE SHALL BE SATURATED SURFACE DRY WITH NO WATER ACCUMULATION.
- REPAIR MATERIALS SHALL BE APPLIED TO FILL VOIDS. FOR PATCH DEPTHS IN EXCESS OF ONE INCH, CONCRETE PATCH SHALL CONTAIN 3/8" PEA GRAVEL AGGREGATE.
- FOR DEEP OVERHEAD AND VERTICAL PATCHES, CEMENTITIOUS MATERIAL (PER ITEM "B" IN THE TABLE OF ACCEPTABLE CONCRETE REPAIR PRODUCTS) MAY BE USED IF APPLIED IN LIFTS. THICKNESS OF LIFTS AND TOTAL THICKNESS OF PATCH SHALL NOT EXCEED THE MAXIMUM THICKNESS RECOMMENDED BY THE MANUFACTURER. A CLEAN, ROUGHED SURFACE SHALL BE MAINTAINED WITH AN APPROPRIATE SETTING TIME, PER MANUFACTURER'S INSTRUCTIONS, FOR PLACEMENT BETWEEN LIFTS. ALTERNATIVELY, THE PATCH SHALL BE FORMED AND CONCRETE PER ITEMS "C" AND "D" ON THE TABLE OF ACCEPTABLE CONCRETE REPAIR PRODUCTS SHALL BE USED. WHEN FORMED, THE CONCRETE SHALL BE EXTERNALLY AND/OR INTERNALLY VIBRATED AS IT IS PLACED IN THE FORMS TO ACHIEVE THE PROPER CONSOLIDATION TO FILL ALL CORNERS OF THE FORMS; ALLOWING SUFFICIENT SPACE AT THE TOP OF THE FORMED AREA TO PROPERLY PLACE AND CONSOLIDATE THE CONCRETE.
- FOLLOWING THE INITIAL SET OF THE CONCRETE AT FORMED AREAS, THE SPACE AT THE TOP OF THE PATCH AREA SHALL BE FILLED WITH PATCHING MORTAR.
- THE SURFACE FINISH SHALL MATCH ADJACENT CONDITIONS.
- FORMS SHALL BE REMOVED AFTER FIVE DAYS OF CURING. PATCHES SHALL BE INSPECTED FOR IMPROPER CONSOLIDATION OR CRACKING AROUND THE PERIMETER OR IN THE PATCH. IF THESE CONDITIONS EXIST, NOTIFY THE CONTRACTING OFFICER FOR POSSIBLE REMEDIAL ACTION.
- MINIMUM CONCRETE COVER TO REINFORCING STEEL FOR "PATCHES," REPAIRS, ETC., SHALL BE AT LEAST 2" FOR CONCRETE EXPOSED TO WEATHER AND 1 1/2" FOR CONCRETE NOT EXPOSED TO WEATHER.
- CONCRETE REPAIR AREAS SHALL BE ALLOWED TO CURE A MINIMUM OF 14 DAYS PRIOR TO SURFACE PRIMING AND PAINTING.

**ACCEPTABLE CONCRETE REPAIR PRODUCTS**

PRODUCT DESCRIPTION	ACCEPTABLE ALTERNATIVE PRODUCTS
A. CEMENTITIOUS MATERIAL FOR HORIZONTAL (TOP) SHALLOW PATCH REPAIRS	<ul style="list-style-type: none"><li>SIKAQUICK 1000</li><li>EMACO T430, BASF.</li><li>MASTERFLOW 713, BASF.</li><li>QUIKRETE FAST SET REPAIR MORTAR (NO. 1241)</li><li>THORITE GENERAL PURPOSE CONCRETE RESTORATION, BASF</li></ul>
B. CEMENTITIOUS MATERIAL FOR OVERHEAD & VERTICAL SHALLOW PATCH REPAIRS	<ul style="list-style-type: none"><li>SIKAREPAIR 223, SIKA CORPORATION</li><li>THORITE RAPID VERTICAL, THORO SYSTEMS</li><li>POWERCRETE POWERTOP GEL PATCH</li><li>SONNEBORN SONOPATCH 200</li><li>EUCO VERTICOAT, EUCLID CHEMICAL COMPANY</li></ul>
C. POLYMER MODIFIED CAST-IN-PLACE CONCRETE FOR ALL DEEP PATCH REPAIRS	<ul style="list-style-type: none"><li>CONCRETE PROPERTIES:<ul style="list-style-type: none"><li>28-DAY STRENGTH = 6000 PSI</li><li>MAX. WATER TO CEMENT RATIO = 0.50</li><li>3/8" DIAMETER PEA GRAVEL</li><li>CALCIUM NITRITE ADMIXTURE</li><li>HIGH RANGE WATER REDUCER (MAX. 6-1/2" SLUMP)</li><li>SHRINKAGE COMPENSATING ADMIXTURE</li><li>LATEX (POLYMER) ADMIXTURE MUST BE INCLUDED, SEE MANUFACTURER FOR PROPORTIONS OF EITHER DILUTED OR UNDILUTED MIX</li></ul></li><li>NOTE: PRE-MIXED BAGGED CONCRETE SUCH AS QUIKRETE (6000 PSI) MIX OR SIKAGROUT 212 WITH PEA GRAVEL (25#/55# BAG OF DRY MIX BUT NOT EXCEEDING 25% BY VOLUME) MAY BE USED W/THE ABOVE ADMIXTURES.</li></ul>
D. SHRINKAGE REDUCING ADMIXTURE	<ul style="list-style-type: none"><li>GRACE ECLIPSE, 2% BY WEIGHT OF CEMENT; 1.5 GALS. PER YD.</li><li>SIKA CONTROL 40, 30 FL. OZ. PER 100 LB. OF CEMENT.</li><li>BASF MASTERLIFE SRA 20, 1.5 GALS. PER YD.</li></ul>
E. STEEL ANCHORS	<ul style="list-style-type: none"><li>1/4" ZINC PLATED HILTI KWIK-CON II HEX HEAD SCREWS IN 1 1/4" DEEP HOLE DRILLED WITH MATCHING DRILL BIT</li><li>1/2" CLIMASEAL REDHEAD TAPCON IN 1 1/4" DEEP HOLE DRILLED WITH MATCHING DRILL BIT</li><li>1/2" SIMPSON TITEN HD MINI IN 1 1/4" DEEP HOLE DRILLED WITH MATCHING DRILL BIT</li></ul>
F. BONDING AGENT	<ul style="list-style-type: none"><li>SIKA ARMATEC 110</li><li>THORO ACRYL 60</li><li>QUIKRETE BONDING ADHESIVE</li></ul>
G. EPOXY TO SET ANY DOWELS	<ul style="list-style-type: none"><li>HILTI HIT-RE 500-SD EPOXY ADHESIVE (INTERIOR APPLICATIONS ONLY)</li><li>HILTI HIT-HY 150 ACRYLIC ADHESIVE</li><li>RED HEAD EPICON C6 EPOXY ADHESIVE (INTERIOR APPLICATIONS ONLY)</li><li>RED HEAD EPICON A7 ACRYLIC ADHESIVE</li><li>SIMPSON SET-XP EPOXY-TIE ADHESIVE (INTERIOR APPLICATIONS ONLY)</li><li>SIMPSON AT ACRYLIC-TIE ADHESIVE</li></ul>



**REPAIR PROCEDURE**

- CHIP OUT ALL LOOSE AND FRACTURED CONCRETE AROUND SPALL. EXTEND LIMITS OF EXCAVATION UNTIL SOUND CONCRETE IS ENCOUNTERED.
- ROUGHEN SURFACE TO 1/4" MINIMUM AMPLITUDE.
- CREATE 1/2" UNDERCUTS CUT AT PERIMETER.
- CLEAN ALL EXPOSED REBAR TO BRIGHT STEEL CONDITION. REPLACE CORRODED BARS WHICH HAVE LOST MORE THAN 20% OF CROSS-SECTION AND/OR AS DIRECTED BY THE ENGINEER (SEE DETAIL 1 THIS SHEET).
- INSTALL 1/4" SCREWS @8" O.C. MAX. EACH WAY. SEE ITEM "F" ON TABLE OF ACCEPTABLE CONCRETE REPAIR PRODUCTS ON THIS SHEET. PROVIDE 1 1/4" MIN. EMBEDMENT INTO SOUND CONCRETE. PROVIDE 3/4" MIN. CLEAR COVER TO HEAD OF SCREW AFTER PATCH INSTALLATION.
- PROVIDE SHADE ABOVE WORK AREA OF PATCHES IF CONCRETE MEMBER IS EXPOSED TO DIRECT SUNLIGHT DURING CURING.
- APPLY BONDING AGENT TO CONCRETE SURFACE. SEE ITEM "G" ON THE TABLE OF ACCEPTABLE CONCRETE REPAIR PRODUCTS ON THIS SHEET.
- INSTALL PATCH MATERIAL ACCORDING TO MANUFACTURER'S RECOMMENDATIONS. SEE ITEMS "A" THROUGH "D" ON THE TABLE OF ACCEPTABLE CONCRETE REPAIR PRODUCTS ON THIS SHEET.
- FINISH AND CURE AS REQUIRED.

**REINFORCING REPLACEMENT NOTES:**

- SEE CONCRETE REPAIR NOTES 2, 5, 6, & 7 FOR GENERAL REPLACEMENT/SUPPLEMENT OF (E) REINFORCING.
- WELDING OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH "STRUCTURAL WELDING CODE-REINFORCING STEEL" (AWS D1.4).
- REBAR FOR SPLICE SHALL BE ASTM A706, GRADE 60.
- PREHEAT BARS ACCORDING TO AWS D1.4 STANDARDS.

**1 TYPICAL CONCRETE REPAIR DETAIL AT SLABS, BEAMS AND COLUMNS**  
N.T.S.

October 2015

MARTIN & CHOCK

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U.S. DEPARTMENT OF THE INTERIOR  
OFFICE OF INSULAR AFFAIRS

INSULAR ABCs PHASE III  
COMMONWEALTH OF  
THE NORTHERN MARIANA ISLANDS

DRAWING TITLE

TYPICAL  
CONCRETE AND  
MASONRY REPAIRS

NO. DATE REVISION

DATE JULY 24, 2015

SHEET

S-1

1 OF 1





## **APPENDIX C**

### **RECOMMENDED COVERED WALKWAY WITH WOOD FRAMING AND METAL DECKING REPAIR PROCEDURE**

### **Existing Conditions:**

There are many instances of covered walkways consisting of metal corrugated decking over wood framing supported by wood, steel, masonry or concrete columns. Sometimes there is plywood decking under the corrugated metal decking.

Deterioration of these structures generally starts with corrosion of the roof framing leading to holes and moisture damage and decay of wood framing below. Where there is plywood decking under the metal decking it is common for moisture to get trapped between the metal decking and plywood, causing mold and decay of the plywood before the metal decking and wood framing deteriorates. It is recommended that when replacing these structures, the plywood be removed and not replaced. Presumably the purpose of the plywood was to add to the in-plane diaphragm strength of the covered walkway roof structure. However, the corrugated metal panels will generally have sufficient diaphragm strength alone. It is unlikely that the roof will fail due to an in-plane failure of the diaphragm during an extreme wind event. It is more susceptible to wind uplift and dependent on: the type of fasteners connecting the decking down to the framing; the strength of the framing, or; the lateral capacity of the columns. To provide adequate wind uplift capacity, appropriately sized wood framing is required and the decking shall be fastened with decking screws rather than nails as they have superior strength in resisting withdrawal from the wood framing. The steel columns must have adequate anchorage at the base of the columns.

The steel decking has a limited lifespan, particularly if not painted. Alternatives to the steel decking should be considered for replacement decking, including non-metallic or aluminum decking sheets with stainless steel fasteners. Selected decking must have appropriate impact and wind resistance.

Sometimes there is deterioration around the base of the steel or other columns. This can be prevented by improved site drainage to prevent ponding around the base of the columns and a good quality waterproof coating around the base of the posts.

### **Recommended Scope of Work for Repair or Replacement of Covered Walkways:**

- 01 Define the area of covered walkways to be replaced and the items to be replaced: decking; purlins; beams; columns.
- 02 For column replacement, columns shall be equal or greater size than the original. Steel posts shall be anchored at the base with a baseplate and four bolt minimum connection or embedded into a concrete footing to match the existing column conditions. Wood posts shall not be used unless the covered walkway is braced back to an adjacent building.
- 03 Replace wood framing as required with sizes equal to or greater than the original sizes. Provide galvanized steel ties to resist vertical uplift forces from the column to joists. Paint the framing with a specified paint system. Framing shall provide at least 1:12 slope in direction parallel to roof decking.

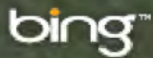
- 04 For decking replacement, remove any plywood decking and install the new specified decking directly to wood framing. Use stainless steel, screw type fasteners.
- 05 Where the geometry or framing needs to be strengthened or modified, contact a licensed structural engineer to design the required components.



## **APPENDIX D**

### **SCHOOL CAMPUS MAPS WITH BUILDING IDENTIFICATION NUMBERS**

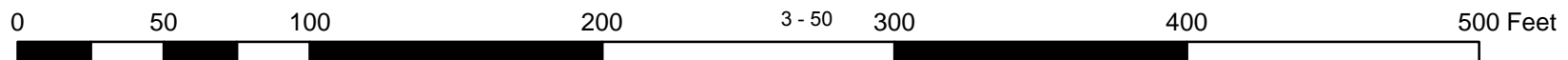




**Helber Hastert & Fee**

**Chacha Oceanview Jr High School**

Date: 5/28/2013







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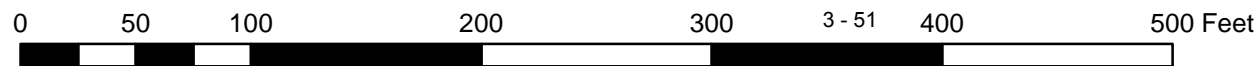
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**Dan Dan Elementary School**

Date: 5/28/2013



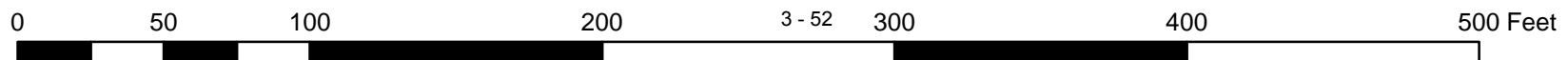




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## G.T. Camacho Elementary School

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**Garapan Elementary School**

Date: 5/28/2013



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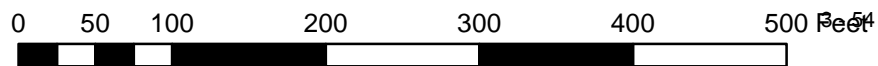




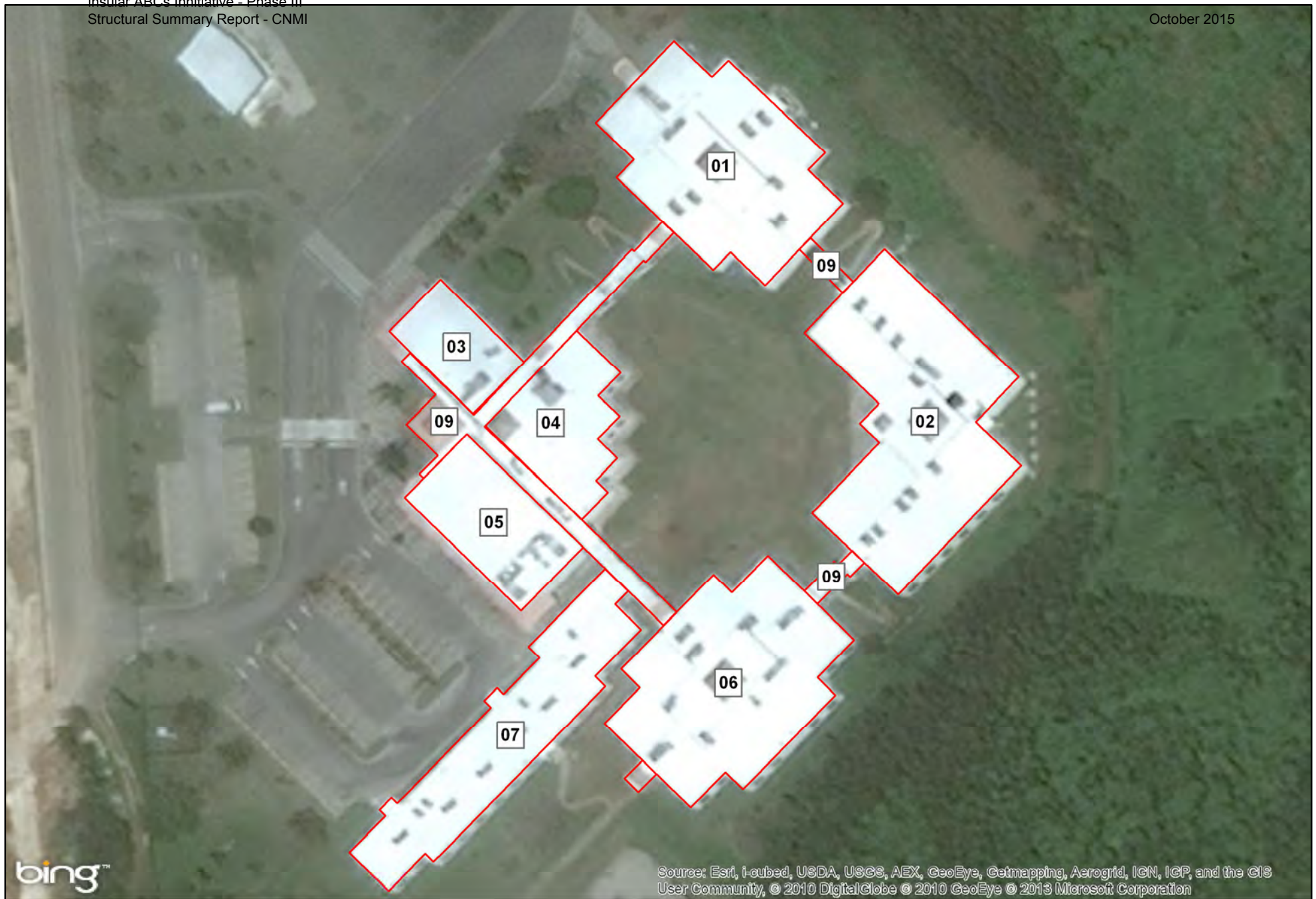
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**Hopwood Jr High School**

Date: 5/28/2013







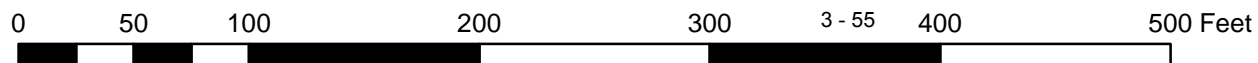
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**Kagman Elementary School**

Date: 5/28/2013



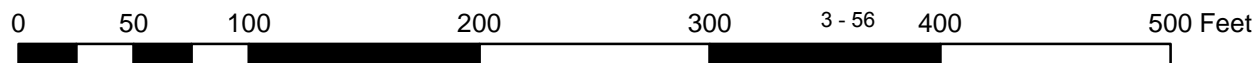




**Helber Hastert & Fee**

## Kagman High School

Date: 5/28/2013



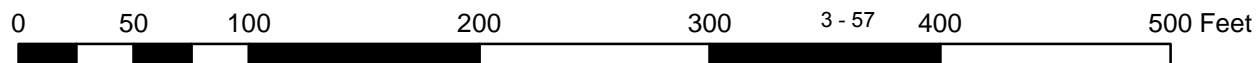




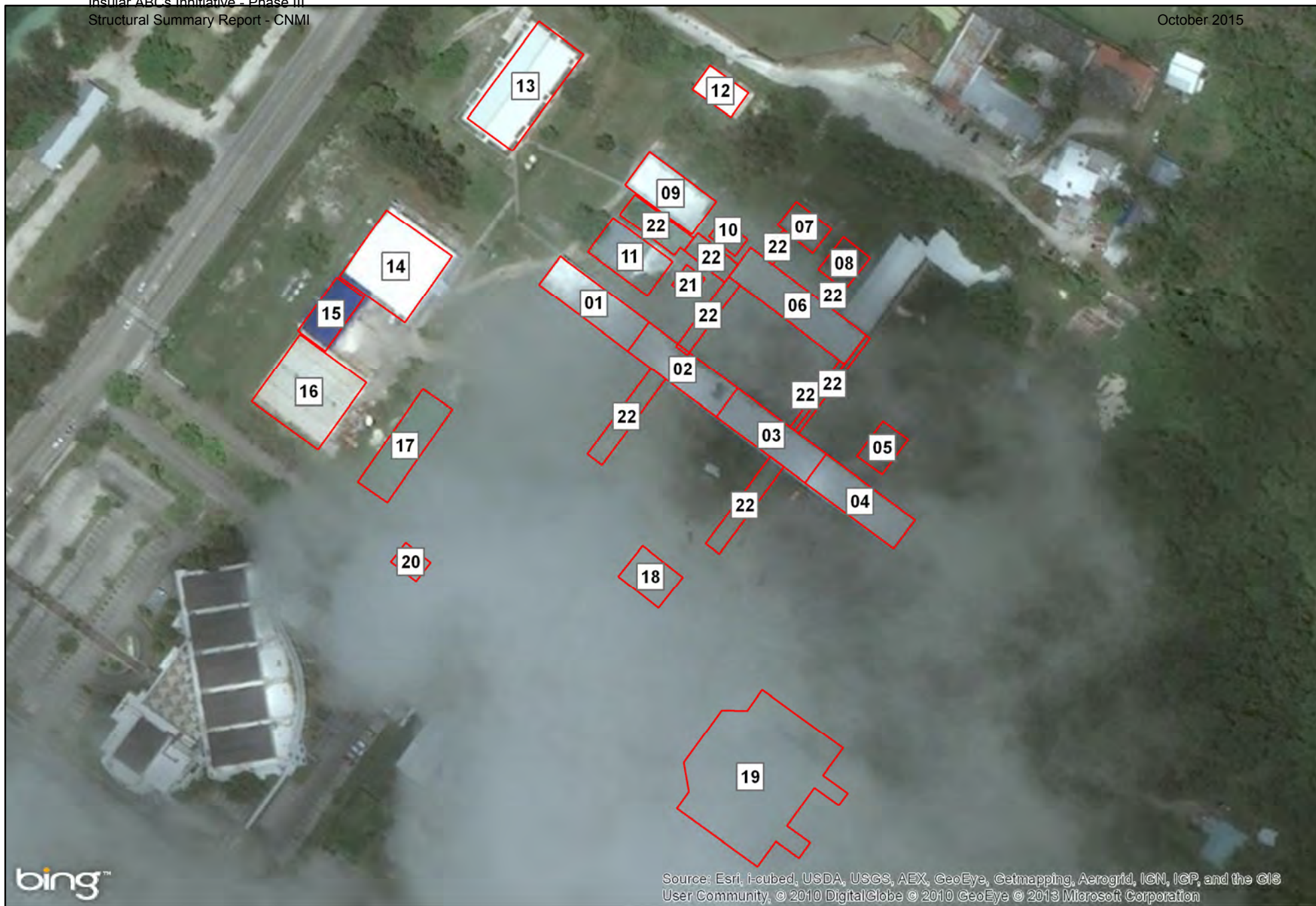
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## Koblerville Elementary School

Date: 5/28/2013







**Helber Hastert & Fee**

## Marianas High School

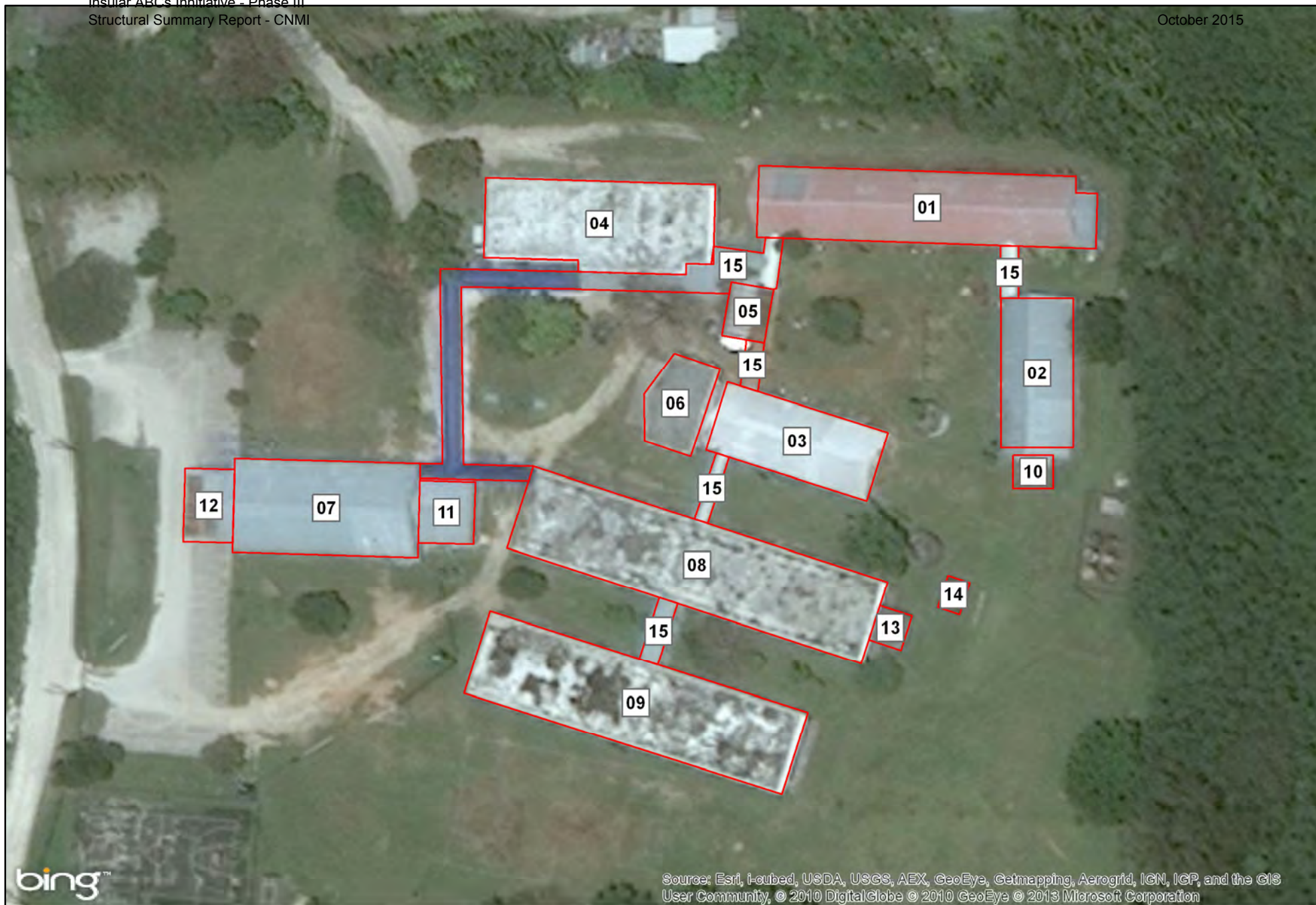
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0 50 100 200 300 400 500 Feet

A horizontal scale bar with alternating black and white segments, corresponding to the 0, 50, 100, 200, 300, 400, and 500-foot increments.

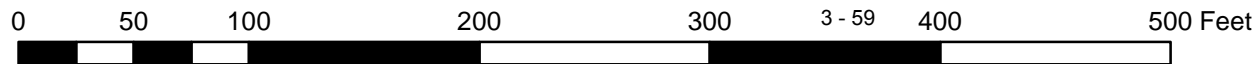




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**Oleai Elementary School**

Date: 5/28/2013



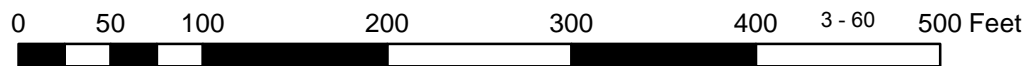




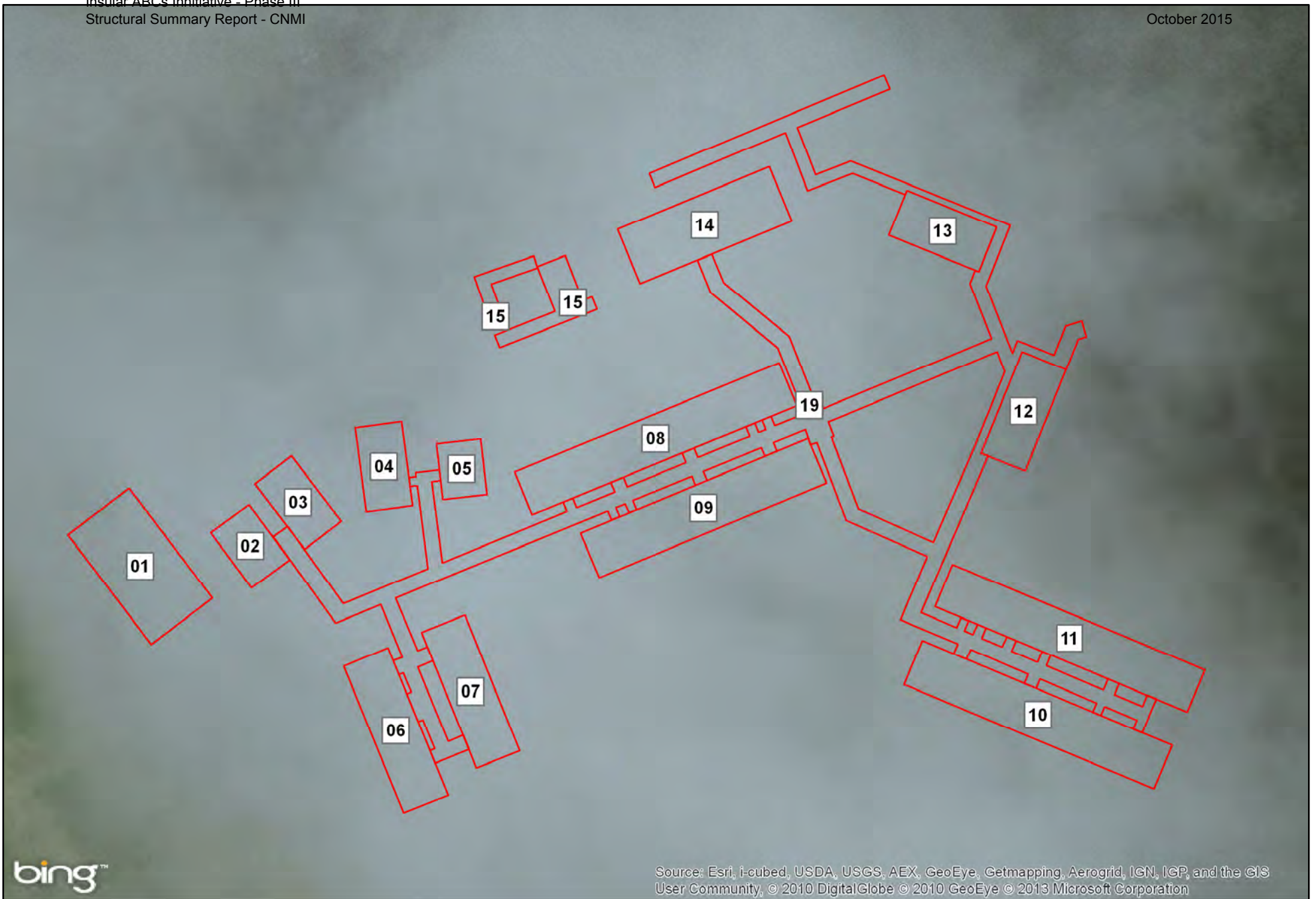
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**Reyes Elementary School**

Date: 5/28/2013



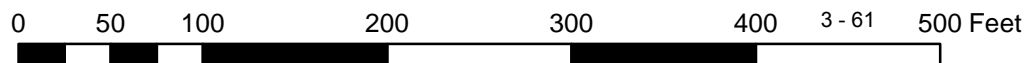


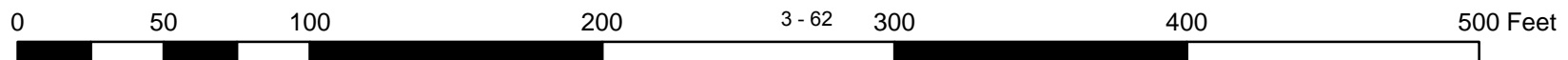
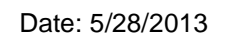


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**Saipan Southern High School**

Date: 5/28/2013





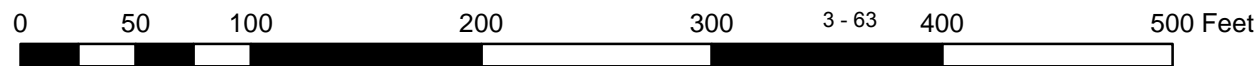




**Helber Hastert & Fee**

## San Vicente Elementary School

Date: 5/28/2013



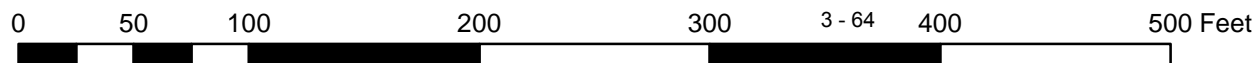




**Helber Hastert & Fee**

## Tanapag Elementary School

Date: 5/28/2013



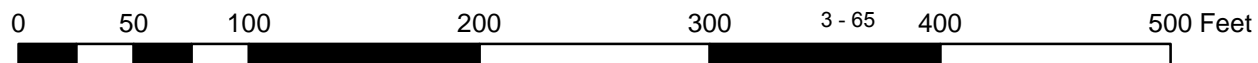




**Helber Hastert & Fee**

## Tinian Elementary School

Date: 5/28/2013



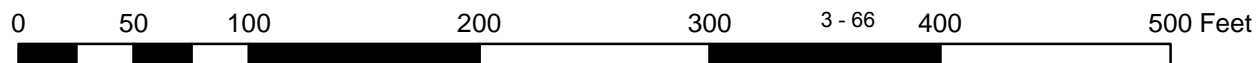




**Helber Hastert & Fee**

## Tinian Jr/Sr High School

Date: 5/28/2013

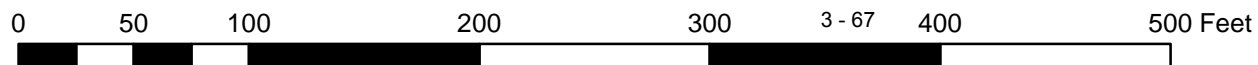




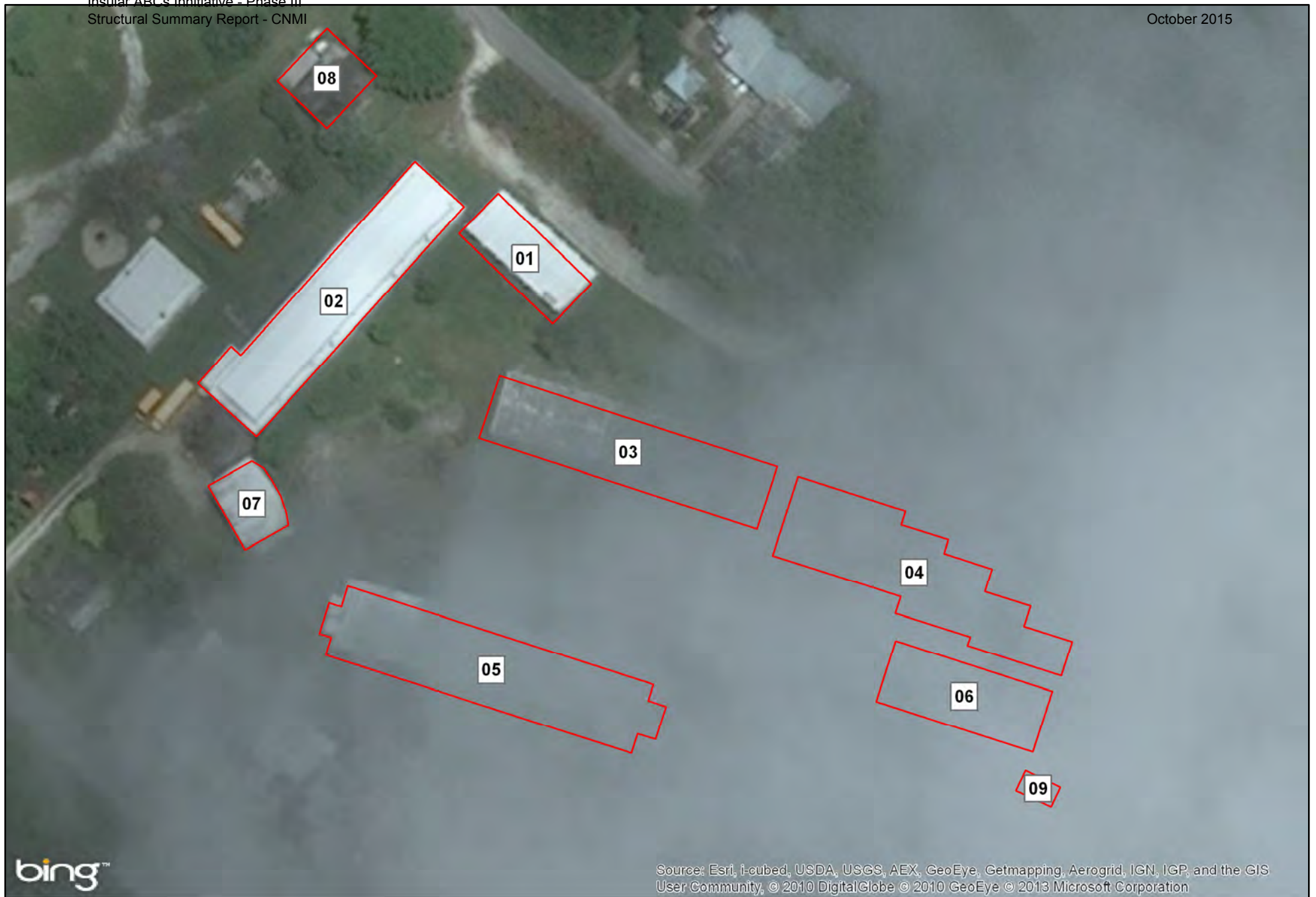
**Helber Hastert & Fee**

**Rota High School**

Date: 5/28/2013



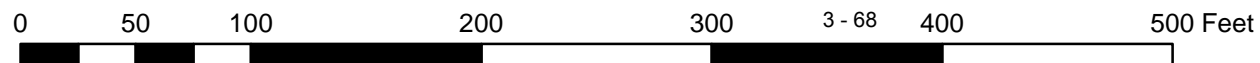




**Helber Hastert & Fee**

**Rota Jr. High School**

Date: 5/28/2013







**Helber Hastert & Fee**

## Sinapalo Elementary School

Date: 5/28/2013

