FIGURE 416. Exposed electrical wiring in lounge.

FIGURE 417. Peeling paint and moisture damage visible at second floor level of concessionaire component.

FIGURE 418. Missing window unit in stair tower.

Second Floor, Concessionaire Component.

- The suspended ceiling tiles in the back hallway on the second level of the concessionaire component are damaged or missing. Exposed wood framing has staining and decay attributed to water damage (Figure 419).
- The ceramic tile floor in the kitchen is deteriorated. Open joints are visible between several of the tiles (Figure 420).
- Exposed conduit in the kitchen exhibits corrosion (Figure 421).
- Exposed ductwork in the kitchen shows signs of corrosion (Figure 422).
- The dining room ceiling shows signs of moisture damage (Figure 423).

FIGURE 419. Deterioration of ceiling tile and framing in rear hallway.

FIGURE 420. Open joints and deterioration of ceramic tile in kitchen.

FIGURE 421. Corrosion of exposed electrical conduit in kitchen.

FIGURE 422. Surface corrosion on exposed ductwork in kitchen.

FIGURE 423. Visible moisture damage and staining to acoustical tile ceiling.

- The track lighting in the dining room is partially detached from ceiling (Figure 424).
- The suspended acoustical tile ceiling in the employee cafeteria shows sign of moisture damage (Figure 425).
- The paint on the plaster walls in the employee cafeteria area is peeling and debonding (Figure 426).

FIGURE 424. Damaged track lighting mounting bar.

FIGURE 425. Deterioration and staining of ceiling framing and acoustical tile in employee cafeteria.

FIGURE 426. Peeling and debonded paint and damage to plaster wall in employee cafeteria.

Structural Description

The visitor center has an expressed concrete structure of columns, beams, and floor slabs which establish an open floor plan. Portions of the structure are enclosed with non-load-bearing masonry walls. The structure consists of a grid of circular reinforced columns measuring 13 inches in diameter and spaced on a grid 18 feet in each direction (Figure 427). According to the original construction documents, each column is cast in place and supported at the foundation level by two concrete piles tied together by a concrete pile cap. The concrete has an oolitic and fossiliferous limestone aggregate with a maximum aggregate size of 3/4 inch. The columns are reinforced by uncoated #3 spiral reinforcing bars and #5 or #6 vertical reinforcing – depending upon column location – that extends to the bottom of the concrete base. The spiral reinforcing bar has approximately 1-1/2 inch clear cover (Figure 428 and Figure 429). A 1/2 inch thick portland cement parge coating was applied over the exposed surfaces of the structural concrete column. The ground floor slab on grade was poured around the grid of structural concrete columns and consists of a 4 inch thick concrete slab reinforced by 10 gauge, 6 inch by 6 inch welded wire mesh.

Two-story tall rectangular piers are located at the north and south ends of the breezeway. The piers measure 13 inches wide by 61 inches deep and are set at a 45 degree angle to the grid of the columns. The west ends of the piers are cast concrete measuring 24 inches deep while the east end of the piers is CMU masonry, grouted solid. The piers have a 1/2 inch thick portland cement parge coating applied over the face of the concrete and are covered by a paint coating .

The columns support cross-shaped concrete girders, measuring 14 inches wide by 24 inches tall, with a 5 inch ledger projecting from either side. The 18 foot long girders cantilever 2 feet 6 inches over the first floor columns, where the ends are dovetailed to 6 inch thick precast concrete spandrel panels. Ten inch tall precast double tees run perpendicular to the girders spanning a distance of 18 feet, and bear upon 3 inch by 3 inch steel angles set on the projecting girder ledgers.

The perimeter spandrel panels are supported by hanger rods embedded into the precast double tees and the concrete topping slab.

FIGURE 427. Structural column grid, as viewed along the breezeway.

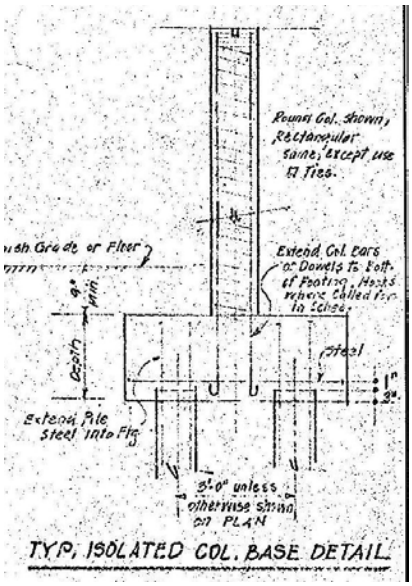

FIGURE 428. Drawing of circular column reinforcing. Typical Isolated Column Base Detail, NPS drawing 160-3020C, "Visitors Center National Park Service Section," February 18, 1956, Sheet 5.

FIGURE 429. A large spall at a first floor column showed a 1-1/2 inch concrete clear cover with 1/2 inch portland cement parge coating.

At the second floor level, columns are located at the perimeter of the structure and bear on 10 inch by 12 inch by 3/4 inch bearing plates anchored above the ends of the concrete girders by four 3/4 inch diameter bolts. The rectangular columns measure 9 inches by 13 inches with #5 or #7 vertical reinforcing bar, depending upon column location, and #2 horizontal ties spaced 12 inches on center. The columns are covered by a 1/2 inch thick portland cement parging. The exterior face of the previously mentioned spandrel panels and the base of the second floor columns are covered in 1/2 inch stucco. A reinforced 3 inch concrete topping slab with finish coat is cast in place over the precast double tee beams and girders to tie the floor structure together. (Refer to Appendix A for copies of selected original construction documents.)

Second floor columns and piers support the roof structure, which consists of precast concrete beams that run along the columns at the perimeter of the structure, and steel bar joists that span between the columns perpendicular to the perimeter concrete beams. According to construction documents, the roof decking is comprised of a transite panel subsurface topped with 3 inch Insulrock and tectum roof planks. At flat roof locations, the decking is supported by steel bar joists that engage the continuous concrete perimeter beam and cantilever 2 feet 10 inches at either end to frame the perimeter overhang. At shed roof locations, the bar joists span perpendicular to the roof slope and outriggers

extend past the face of the wall to frame the roof overhang. Steel hangers are strapped to the bottom of the joists with wire ties and support a plaster ceiling on wire lath.

Throughout the structure, there are variations in the typical column grid and framing member sizes and spacing. At the first floor level of the breezeway, the column grid has a modified 18 foot by 12 foot configuration.

The center row of columns in the plaza under the south wing of the concessionaire component are capped by 3 inch thick galvanized bearing plates that supports concrete girders.

Centered in the last structural floor framing bay under the south and north components of the building are large T-shaped concrete beams cast in place over a steel wide flange and cantilevered over the last row of columns. Under the concessionaire component, the beam ties to the back of the precast concrete spandrel beam. The office and museum component beam extends through the spandrel beam and provides support for a projecting exterior stair on the north elevation.

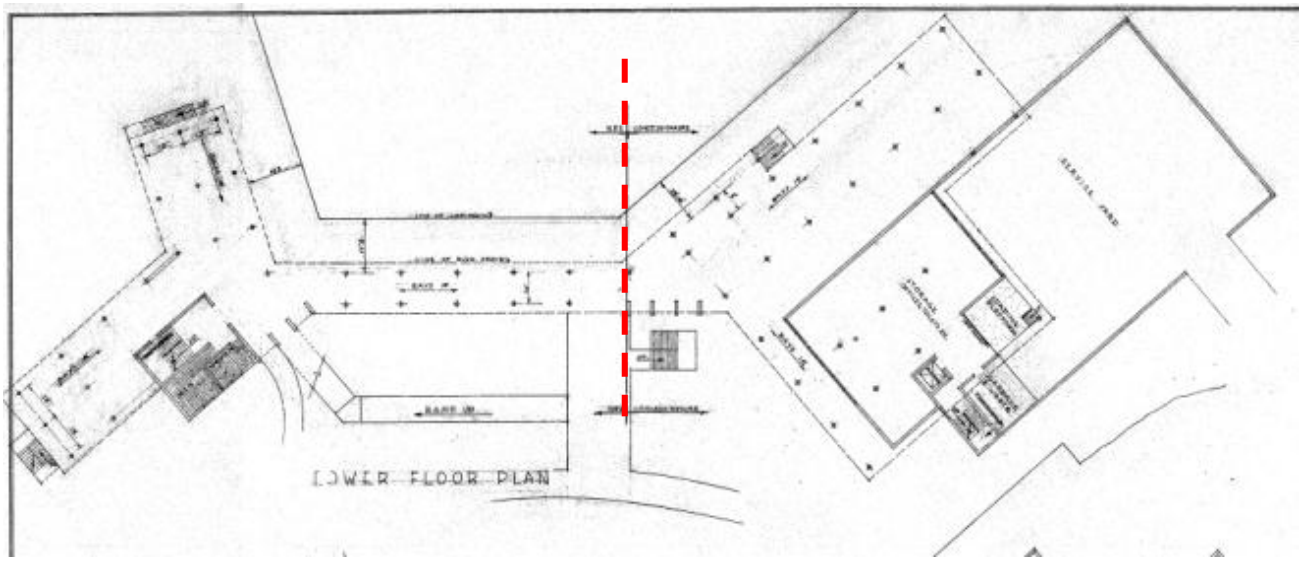

FIGURE 430. Original construction drawings define the boundary between the office and museum component and concessionaire component contracts. The line corresponds to an existing expansion joint in the as-built construction. NPS drawing 160-3020C, "Public Works Building at Everglades," February 1, 1956, Sheet 1.

An expansion joint is located at the south end of the breezeway between a concrete girder and a 13 inch by 17-1/2 inch cast in place sistered beam. Based on archival documentation, the concessionaire component, breezeway, and office and museum component were constructed simultaneously but under different contracts (Figure 430). The expansion joint signifies the break between the separate construction contracts. A metal clip angle is located at either end of the expansion joint where the girder meets the dovetailed spandrel beam. The beams on either side of the expansion joint are separated by a layer of rosin paper and connected by three threaded rods and metal dowels inserted through the north side of the concrete girder and embedded in the cast in place beam. Physical evidence suggests that the metal clip angles and girder were a part of the original construction and that the cast in place concrete beam was a later addition to address perceived structural deficiency.

Located at the south end of the visitor center is a service yard that is partially surrounded by a concrete block screen wall. The wall is constructed on a continuous foundation wall with uncoated #3 reinforcing bars positioned

horizontally and vertically in the hollow core of the block. The wall is capped by a 12 inch tall cast in place concrete coping slab and covered with a 1/2 inch thick stucco finish coat.

Laboratory Materials Analysis

During the investigation of the concrete structure, three locations were selected for concrete core removal to evaluate underlying conditions and to understand the differences in mix design at various locations in the building. Cores removal locations were selected at various structural elements. A summary of laboratory findings is presented below. Detailed discussion of findings of the concrete materials studies is included in the laboratory report provided in Appendix B.

One core (Core 1) was taken from the concrete slab at the second floor breezeway. The sample is approximately 3-3/4 inches in length and consists of a base concrete that is 3-1/2 inches long with a 1/4 inch-thick topping. The topping has a yellow integral color and includes fine siliceous sand and coarser carbonate sand particles. The base concrete contains three distinct layers with a similar aggregate composition and slightly differing matrix appearance. The uppermost layer is 1 inch thick and has a grey cementitious matrix color. The middle layer also has a grey matrix color and measures 1-1/4 inch. The bottom layer consists of a dark brownish-grey matrix color and is 1-1/4 inch thick. A viable explanation for the variation in color between the three concrete layers may be differences in water/cement ratios.

All base concrete layers are composed of course and fine aggregate consisting of oolitic and fossiliferous limestone fragments with a portion of quartz particles. The coarse aggregate is angular and the fine aggregate is sub angular to sub rounded. The maximum aggregate dimension in the core is 3/4 inch.

It was observed during testing that the bond between the topping layer and base concrete was poor and that the middle layer and bottom layer of the base concrete were marginally bonded.

Compressive strength testing and carbonation depth were tested on the core. The compressive strength was measured at 7,310 psi. Carbonation was identified at a depth of 1/32 inch in the topping slab and 1/4 inch from the bottom of the base concrete and was not in close proximity to the reinforcing bar. Carbonation is a chemical reaction that occurs in concrete exposed to atmospheric carbon dioxide that results in a lowering of the pH of the concrete and can promote corrosion of the reinforcing steel.

A second core (Core 2) was removed from a second floor column at the visitor center and therefore has a horizontal orientation. The sample is approximately 6-3/8 inches long and consists of a 1/8 inch mortar face layer and a 6-1/4 inch concrete base. The mortar face layer contains a soft gray matrix with rounded (natural) aggregate comprised of mostly siliceous with some carbonate sand. It was observed that the mortar face layer was marginally bonded to the base concrete. The base concrete includes coarse aggregate with a maximum dimension of 7/8 inch. The coarse aggregate is angular oolitic and fossiliferous limestone. The fine aggregate within the concrete is similar in composition to the large aggregate; however, the shape ranges from sub angular to sub rounded.

Chloride testing was performed on the core at depths of 1/2 inch and 1-1/4 to 1-3/4 inches from the exterior face of the core. The chloride content was measured at 0.012 percent at a depth of 1/2 inch and 0.014 at a depth of 1-1/4 to 1-3/4 inch and are within the range of experimental error. Thus, the chloride content of the two depths was found to be essentially the same. Studies have shown that chloride contents above 0.02 to 0.03 percent by mass of concrete, depending on cement content, can promote corrosion of embedded steel in non-carbonated concrete. Both values are less than the chloride content levels which promote steel corrosion in non-carbonated concrete.

A third core (Core 3) was removed from the visitor center east facade spandrel panel and has a horizontal orientation. The core consists of an unbonded mortar face layer approximately 11/16 inch thick and a 5-1/16 inch concrete base which

includes a 1/32 to 3/32 inch thick buff-colored mortar layer. Upon removal of the core from the visitor center facade, the mortar face layer was observed to be separated from the buff-colored mortar layer and concrete base.

The mortar face layer consists of sub angular/sub rounded siliceous sand with carbonate fossil shell fragments and has a grey-colored matrix. The top surface of the mortar face layer is coated with paint.

The buff-colored layer is bonded to the concrete substrate. The aggregate is similar to that in the grey mortar face layer with sub angular/sub rounded siliceous sand with carbonate fossil shell fragments.

The zone in the base concrete immediately beneath the buff mortar layer has a lighter colored matrix, a possible indication of carbonation. The aggregate in the underlying concrete is angular/sub angular oolitic and fossiliferous limestone with a maximum dimension of 1 inch. The fine aggregate is of similar composition to the large aggregate; however, the particle shapes vary from sub angular to sub rounded.

In addition to the cores described above, one stucco sample (Sample 6), approximately 5 inch by 2 inch, was removed from the south facade of the visitor center. The stucco contains fine grained mostly siliceous aggregate, quartz with an angular/sub angular shape. The cement matrix is hard and contains portland cement particles and lime lumps or soft limestone aggregate particles. There is a lighter colored band in the mortar that follows the contours at the top of the surface. The lighter color is the result of preferential carbonation in this region. A darker colored band is located directly under the surface coating and has an irregular pattern of dissipation. The darker colored band could be indicative of a low water/cement ratio or the previous application of a penetrating surface primer.

Carbonation depth were tested on the sample and found to range from 1/8 inch to 1/4 inch from the finished surface and was not in close proximity to reinforcing bar.

Another sample (Sample 7) was removed from a first floor column at the visitor center and includes an approximately 8 inch by 4 inch section of patch material with a brown paint coating. The section contains three layers of mortar. The top layer is 3/16 to 5/16 inch thick and has one layer of paint coating on the outer surface. A portion of the top layer extends into the second layer, this may indicate that the lower layer was tooled prior to the application of the top layer of mortar patch material. The middle layer is 3/8 inch thick and the third layer extends into the depth of the sample. Each layer contains fine grained siliceous aggregate likely quartz that is sub angular to sub rounded.

Structural Condition Assessment

All visitor center masonry and concrete was visually surveyed and sound tested with a masonry hammer to locate deteriorated or unsound material. The following notable conditions were observed:

- Deterioration was observed on second floor columns in the form of cracking and concrete spalling. The deterioration was more severe at the base of columns (Figure 431 and Figure 432). Existing physical evidence suggests that the cracking and spalling is associated with corrosion of the embedded reinforcing bars in the concrete.

- Cracks were noted at the second floor breezeway level. The cracks were located above the precast girders and typically extended perpendicular to the walkway between columns. The largest cracks measured 3/16 inch in width and were located at the north end of the breezeway (Figure 433).

- Significant reflective cracking and spalling of the stucco were observed on the exterior face of the spandrel panels (Figure 434). The cracks correlated with the location of construction joints between the concrete girders, spandrel panels, and cast-in-place topping slab.

- Step cracking, spalling, horizontal cracking, holes, and organic growth were observed on the CMU screen wall surrounding the service yard. Considering the shallow foundation of the wall, the step cracking is most likely associated with differential settlement and lateral movement (Figure 435). Spalling and horizontal cracking were observed in close proximity to observed corroded reinforcement bars (Figure 436).

- Delaminated concrete was noted on second floor columns. The stucco coating at areas of delamination was typically cracked.

FIGURE 431. Concrete spalling and exposed corroded reinforcing bar at the base of second floor column.

FIGURE 432. Concrete spalling and associated cracking at the base of second floor column.

FIGURE 433. Crack in the second floor concrete floor slab.

FIGURE 434. Horizontal cracking in raised stucco panels.

FIGURE 435. Step cracking in screen wall.

FIGURE 436. Open mortar joints and exposed corroded reinforcing bar.

- Spalling was observed at the bottom of one first floor column (Figure 437). This deterioration was attributed to corrosion of reinforcing bar embedded in the concrete and impact damage caused by the close proximity of the columns to a bicycle rack.

- Minor spalling and exposed reinforcing bar were noted on the underside of the concrete double-tees (Figure 438). The damage is attributed to insufficient concrete clear cover and subsequent corrosion of the embedded reinforcing bar.

- Spalling of stucco and corroded metal support anchors were observed at base of second floor spandrel panels and walls. (Figure 439). The spalling was attributed to corrosion of the metal anchors.

- Corrosion, corrosion staining, and concrete spalling were observed near several bearing angles below double-tee beams where they meet the girder ledger (Figure 440). The damaged areas were located primarily under the first floor entrance to the office and museum component.

FIGURE 437. Spalling at the bottom of a first floor column located at north end of the office and museum component of the building.

FIGURE 438. Exposed corroded reinforcing bar and associated spalled concrete.

FIGURE 439. Spalling of stucco and corroded metal anchors.

FIGURE 440. Corrosion of bearing angles and spalling of adjacent precast concrete framing member.

- Corrosion was observed on the exposed bottom flange of the beam embedded in the concrete T-beams located in the last framing bay of the office and museum and concessionaire components (Figure 441).

- Steel plates located below the expansion joint were observed to be severely corroded. Spalling of concrete adjacent to the plates was observed (Figure 442).

- Evidence of movement of the structure was observed at the expansion joint. Minor cracking was observed in this location and the east end of the cast-in-place sistered beam had displaced approximately 1 inch below the level of the spandrel panel (Figure 443).

- Previous concrete repairs and patches were observed on second floor columns. The repairs were located primarily at the column corners and had been coated to match the existing finish (Figure 444).

- Repairs were made to concrete columns and the second floor breezeway stucco ceiling in 2010 by Park Facilities staff (Figure 445 and Figure 446).

FIGURE 441. Corrosion of the exposed bottom flange embedded in the concrete T-beam.

FIGURE 442. Severely corroded metal clip angle supporting construction joint.

FIGURE 443. Open joint at spandrel panel and displacement of sistered concrete beam.

FIGURE 444. Previous repairs of cracks and spalls at the corner of the column have been covered with a paint coating.

FIGURE 445. Concrete repair of first floor column at north end of visitor center, June 2010.

FIGURE 446. Replacement of stucco ceiling at second floor breezeway in progress, June 2010.

Service Station

Exterior Description

Located at the northern edge of the Flamingo Developed Area, the service station is a one story reinforced concrete, steel, and masonry structure. The building contains aluminum-framed windows and wood doors with glazed panels. Two canopies supported by steel pipe columns cover the gasoline pump islands (Figure 447).

The two canopies extend nearly twenty feet to the south and west from the service station. The steel-framed canopies have stucco fascias painted a buff color at their perimeter. Small incised painted wood signs display the canopies' clearance heights. Each canopy is supported by two six-inch steel pipe columns, which rest on the former gasoline pump islands (Figure 448). The concrete islands sit approximately 6 inches above the paving. Currently none of the gasoline pumps remain. The undersides of both canopies are covered with stucco painted a buff color that matches the rest of the building.

With the exception of the two canopies, the covered open air service area on the northeast portion of the building is one of the most prominent features of the service station (Figure 449). The roof of the service area is approximately four feet above the main roof level. The roof has a wood fascia painted a brown color at its perimeter.

The building roof surface is not visible, but the perimeter of the roof has an unpainted galvanized sheet-metal edge flashing that partially covers the fascia; a flashing of this type is indicated on the construction drawings for the building, and the existing flashing may be original. The construction drawings do not indicate any slope for the original roof; water was intended to drain freely over the perimeter edges.

The north elevation of the service station is defined by a windowless CMU wall clad in 1-1/4 inch Keystone veneer (Figure 450). The wall defines the north side of the open air service area, which is the tallest portion of the structure. The roof of open service area sits above the Keystone veneer-clad CMU wall.

FIGURE 447. View from the southwest of the service station.

FIGURE 448. South canopy.

FIGURE 449. Open air service area.

To the west is another north-facing Keystone-clad exterior CMU wall, also without windows (Figure 451). Unlike the taller portion of the building where the service area is located, the fascia at this part of the building is stucco, painted buff. Adjacent to the Keystone veneer wall is an opening which leads to the women's restroom. A concrete block column covered in stucco painted a buff color defines the western portion of the opening.

The most prominent feature of the east elevation is the covered open air service area (Figure 452). Three 6 inch diameter steel pipe columns serve as supports for this roof. The underside of the service area roof is painted wood paneling (Figure 453).

Beyond the steel pipe columns, at the back of the service area is a concrete block wall covered with stucco and painted a buff color to match the rest of the building. Painted plywood covers what originally was a louvered vent opening at the northernmost part of the wall (Figure 454). There are two sets of double doors to the south of plywood-covered opening (refer to Figure 449). The first set of doors is wood, painted brown, and leads to a tool closet. The second set of doors is louvered and also made of wood and painted brown. This set of doors leads to a small closet that housed compressor lube pumps. A recessed wood door with glass panels is located at the southern end of the service bay and leads to the former service station office (Figure 455). Above the three doorways, situated between the service bay roof and the main service station roof, are two louvered vent openings. The fascia of the main roof extends into the service area under the vent openings.

Set back from the service bay, the second of two canopies present on the building extends outward to the south from the service station office. A former window now covered in plywood is present under the north portion of the canopy (Figure 456).

FIGURE 450. North elevation

FIGURE 451. The west half of the north elevation is stepped back from the east half.

FIGURE 452. View from the southeast. Note the service area at the right and the south canopy at the left in this photo.

FIGURE 453. Service area roof.

FIGURE 454. Painted plywood covers what appears to be a vent opening.

FIGURE 455. Service station office door is recessed on east elevation.

FIGURE 456. East elevation of the south canopy.

Non-original vertical wood paneling painted brown clads the wall above the window glazing. This paneling is attached to the original aluminum window framing, from which original jalousie sash were removed. Concrete block covered with stucco painted a buff color is present below the windows.

The covered service area is open to the south (Figure 457). The northern wall of the service area is a concrete block wall covered with stucco painted a buff color.

Adjacent to the service bay to the west and beneath the south canopy is a south-facing Keystone veneer wall at the service station office. The middle portion of the south elevation at the office includes two aluminum-framed windows set on a concrete block base covered by stucco painted a buff color. Above the windows is non-original vertical wood paneling painted brown (Figure 458). West of the window openings the wall is covered in Keystone veneer. The service station office exterior wall sits approximately six inches above ground level on a painted concrete curb.

Extending above the main service station roof, the roof over the service area is visible over the northern half of the west elevation. At the northern edge of the building, a former vent opening has been covered with vertical wood paneling painted to match the adjacent stucco covered concrete block (Figure 459).

FIGURE 457. View of the service area from the south.

FIGURE 458. South elevation of the south canopy.

FIGURE 459. Wood covered opening at north end of west elevation.

Moving south, the building bumps out to the west where a series of precast concrete louvers comprise a screen wall in front of the restrooms (Figure 460). An opening is situated south of the louvered screen wall. Next to the opening, the service station office extends to the west. Two aluminum-framed windows and a wood door with a glass panel are located in the west exterior wall of the office space. On the north side of the service station office, a single aluminum-framed window is set on a concrete block base that has been covered with stucco painted a buff color. Non-original vertical wood siding painted brown is present above the windows and door (Figure 461).

FIGURE 460. Precast concrete louvered screen wall conceals the restroom entrances.

FIGURE 461. West elevation of the west canopy.

Exterior Condition Assessment

At the exterior of service station, the following notable conditions were observed:

- A piece of Keystone veneer is missing from the north wall of the service station office (Figure 462).
- Organic growth on the Keystone veneer is present throughout, particularly at the east side of the north elevation (Figure 463).
- The stucco fascia on the canopies is cracked and spalled (Figure 464).
- The stucco covering the concrete block wall is cracked throughout all elevations (Figure 465).
- There are several locations of peeling paint on the underside of the canopies and the stucco-covered concrete block walls (Figure 466).
- A window on the east elevation is missing glazing (Figure 467).
- The roof surface was not visible during the field work for the HSR project. The galvanized metal edge flashing is in good condition.

FIGURE 462. Missing Keystone veneer panel.

FIGURE 463. Organic growth on Keystone veneer panel wall.

FIGURE 464. The stucco fascia at the canopies is cracked and spalled.

FIGURE 465. Vertical cracking in stucco-clad wall.

FIGURE 466. Peeling paint on the underside of canopies. Note signage indicating clear height of canopy overhang.

FIGURE 467. Board-up over missing window glazing on the east elevation.

Interior Description

The interior of the service station consists of three main interior spaces: the service station office, the restrooms, and the service area closets.

The primary interior space in the service station is the office (Figure 468 and Figure 469). The office is an irregularly shaped room that is accessible through two doors, one on the east side of the room and one on the west side. All of the exterior walls of the room contain aluminum-framed windows. The walls and ceiling of the room are plaster while the floor is concrete.

A small storage room is located in the northeast corner of the office is accessible from a wood door (Figure 470). The storage room has plaster walls and ceilings as well as a concrete floor. There are built-in wood shelves on the north and east walls of the room.

FIGURE 468. East wall of office.

FIGURE 469. Southeast corner of office.

FIGURE 470. Storage room accessed from office.

There are two small restrooms in the service station. Both the men's and women's restrooms are rectangular in plan with yellow ceramic tile floors combining square units of two sizes and rectangular units in a random ashlar pattern (Figure 471). The walls and ceilings of the restrooms are plaster with ceramic tile wainscoting (Figure 472). These finishes appear to be original.

The men's restroom has a sink, floor-mounted urinal, and toilet (Figure 473). The women's restroom has a sink and toilet. The existing plumbing fixtures appear to date to the original construction of the service station. Both restrooms are accessed through wood doors on the west side of the room.

There are two closets located off the open service area. The larger tool closet is accessed through a set of wood doors (Figure 474). The walls and ceiling in the tool closet are plaster while the floor is concrete. There is exposed conduit as well as a circuit breaker panel in the tool closet.

The compressor lube pumps closet is accessed through a set of double louvered wood doors (Figure 475). The walls and ceilings in the room are plaster while the floor is concrete. There is exposed conduit throughout the closet.

FIGURE 471. Floor tile in restroom facilities.

FIGURE 472. Typical restroom finishes include plaster walls and tile wainscot.

FIGURE 473. Men's restroom.

FIGURE 474. A large closet accessed from the open air service area. The left hand door (as seen in this view) has been damaged and removed.

FIGURE 475. The compressor lube pump closet. The doors have paint failure and wood decay.

Interior Condition Assessment

At the service station interior, the following notable conditions were observed:

- There are several instances of peeling paint throughout interior spaces (Figure 476).
- There is an insect infestation problem in the closets adjacent to service area (Figure 477).
- Several of the wood doors are damaged (refer to Figure 474).
- Corroded conduit was observed in the service station office (Figure 478).

FIGURE 476. Peeling paint on the office ceiling.

FIGURE 477. An insect infestation problem is present in the closets adjacent to service area.

FIGURE 478. Surface corrosion on electrical conduit in office.

Structural Description

The service station has a reinforced concrete and steel structure. According the original construction documents, the structure sits on a reinforced concrete footing that is ten inches deep and one and one half feet wide. The footing contains two continuous #5 reinforcing bars. Eleven reinforced concrete columns of varying sizes are located at the corners of the building. Steel tube columns were utilized at the corners of the service station office. Concrete block was used for the wall areas between the various columns.

The roof of the structure is steel-framed and contains a wood deck. The canopies and service station roof are supported by six inch diameter steel tube columns. The columns are encased in concrete at the footings.

Structural Condition Assessment

Since much of the service station structure is concealed by nonstructural finish materials, only selected portions of the structure could be assessed:

- Steel pipe columns at service area and at gasoline pump islands show signs of surface corrosion (refer to Figure 449)

- Exposed steel reinforcement that shows signs of corrosion (Figure 479)

FIGURE 479. Exposed and corroded reinforcing bar.

Boat Shelter

Description

The boat shelter is a two-story exposed concrete structure that functions as a boat slip for National Park Service vessels. The shelter is situated on the north bank of the manmade boat basin located in the maintenance area on the east side of the Flamingo Developed Area (Figure 480). Although the maintenance area boat basin opens to the "fresh" water side of the Buttonwood Canal plug, the water of the basin is actually brackish. The open-air structure consists of a precast concrete canopy supported by cast-in-place concrete columns on concrete pile foundations which divide the shelter into three structural framing bays (Figure 481). Wood-framed finger piers span in a north-south direction between the pile caps. The rectangular plan measures approximately 90 feet wide by 40 feet deep and 28 feet tall and is accessed from land on the north and from the water on the south.

FIGURE 480. Overall view of boat shelter and basin.

FIGURE 481. South elevation of the boat shelter.

The boat shelter is supported on a grid of concrete piles that are submerged in the basin and have cast-in-place concrete pile caps. The shelter is four pile caps wide and two caps deep, with each pile cap supporting paired cast-in-place concrete piers connected by a cross member. The piers stand approximately 24 feet tall by 8 feet wide and have a 12 inch square cross-section (Figure 482). Uncoated #4 reinforcement bars were set vertically and tied horizontally into the columns with a 1-1/2 inch cover. The four corner supports are comprised of two connected H-shaped piers orientated perpendicular to each other. The accoupled concrete pier with cross member support coupled precast concrete girders that span approximately 50 feet in a north-south direction and have tapered ends. Each girder cantilevers approximately 48 inches beyond the face of the accoupled concrete pier with a cross member. Between each set of girders span eleven precast reinforced double-T beams (Figure 483). The double-T beams cantilever approximately 6 feet beyond the east and west end girders. Based upon visual observation from grade, atop the double Ts is a concrete topping slab and galvanized metal edge flashing.

The 3 foot wide finger piers are constructed of two parallel wood beams connected through intermediate wood blocking and lag bolts. The piers spans between the end pile caps and are supported by an additional concrete pile cap at mid-span. Steel angles with stiffener plates secure the wood-framing to the concrete piles. A wood top plate runs along the top of each beam and is

reinforced with metal gusset plates bolted to the side of the beam and underside of the top plate. Nominal 2x6 wood planks run perpendicular to the framing and are nailed to the top plate and fastened to the beams with counter-sunk lag bolts.

There are three types of light fixtures on the boat shelter, all of which are surface-mounted with conduit exposed to view. Suspended pendant lights with warehouse-style metal shades hang from the underside of the exposed double T beam ceiling (Figure 484). There are four fixtures per framing bay that provide downlighting for the interior space of the shelter. Based on visual observation from grade, the pendant lights appear to be approximately 20 inches in diameter. Based on historic views of the structure, these fixtures are likely original.

There are two industrial flood lights mounted to the outside face of the west end girder beam (Figure 485). The wide diameter flood lights illuminate the basin to the west of the boat shelter. Based on historic views of the structure, these fixtures are likely original. A third flood light is located at the outside face of the east girder (Figure 486). The lamp has a rectangular shape and is directed toward the pavement directly east of the shelter.

The roof of the boat shelter was not visible during the field survey.

FIGURE 482. Accoupled concrete pier with cross member.

FIGURE 483. West elevation of the boat shelter.

FIGURE 484. Pendant light fixtures mounted to the underside of the boat shelter framing.

FIGURE 485. Flood light fixture located at the west end of the boat shelter.

FIGURE 486. Flood light fixture located at the east end of the boat shelter.

Laboratory Materials Analysis

During the investigation of the concrete structure, one location was selected for concrete core removal to evaluate underlying conditions and mix design. The core was taken from the land-facing side of the northeast cast-in-place concrete corner pier, approximately 4 feet above the concrete pile cap. A summary of laboratory findings is presented below. Detailed discussion of findings of the concrete laboratory materials studies is included in the laboratory report provided in Appendix B.

One core (Core 4) was removed from a column at the boat shelter and has a horizontal orientation. The concrete core is approximately 4-3/4 inch long and consists of one layer. The concrete core includes course and fine aggregate consisting of oolitic and fossiliferous limestone. The course aggregate has an angular shape and has a maximum dimension of 1-1/8 inch. The shape of the fine aggregate ranges from sub angular to sub rounded. The matrix contains portland cement particles and is slightly lighter in color than the matrix observed in the concrete core samples taken from the visitor center.

Compressive strength, chloride content and carbonation depth were tested on the core. The compressive strength was measured at 6,090 psi.

The chloride content was 0.004 percent at depths ranging from 0 to 1/2 inch from the surface of the core and reached 0.038 at depths ranging from 1-1/4 inch to 1-3/4 inch. Variation in chloride content at depths of 0 to1/2 inch and 1-1/4 to 1-3/4 inch are expected; however, typically, the exposed surface has a higher chloride content than the interior of the sample particularly because the sample was removed from a brackish marine environment. The value of 0.038 at 1-1/4 inch to 1-3/4 inch depth is greater than the 0.02 to 0.03 percent chloride content levels which promote steel corrosion in non-carbonated concrete.

Carbonation depth was measured at 1/2 inch from the face of the core and 1/16 inch from the cored surface and was not in close proximity to the reinforcing bar.

A sample (Sample 5) consisting of an approximately 5 inch by 3 inch concrete fragment was removed from a spalled area of the boat shelter concrete. The sample included an area of thick iron oxide staining. The course aggregate is angular and sub angular oolitic and fossiliferous limestone with similar more rounded fine aggregate. The cement matrix includes portland cement particles. The sample has a variation in matrix color with a lighter color extending down approximately 5/8 inch from the smooth exposed surface.

Chloride content and carbonation testing were conducted on the sample. Chloride levels were found to be 0.329 percent at 3/4 to 1-1/4 inches in depth. The level of chloride is greater than the 0.02 to 0.03 percent chloride content levels which promote steel corrosion in non-carbonated concrete.

Carbonation depth was measured at 5/8 inch from the surface of the sample and correlated with the previously noted observed variation in matrix color.

Condition Assessment

All boat shelter concrete was visually surveyed and concrete accessible from grade was sounded with a masonry hammer to determine structural integrity. The following notable conditions were observed:

- Cracking and spalling concrete and corroded reinforcing bar were observed at the cantilevered tapered ends of the double-T beams (Figure 487). The spalling was attributed to corrosion of the reinforcing bars embedded in the concrete.

- Cracking and spalling of concrete and corrosion of reinforcing steel were observed at concrete piers (Figure 488 through Figure 490).

FIGURE 487. Spalling of concrete and exposed reinforcing bar at end of precast T-beam.

FIGURE 488. Spalling and exposed corroded reinforcing bar at base of concrete pier.

FIGURE 489. Spalling and exposed corroded reinforcing bar on concrete pier.

FIGURE 490. Corrosion staining at base of concrete pier.

- Localized concrete cracking and spalls, and corrosion of exposed reinforcing steel, were observed on the face of the piers (Figure 491). Reinforcement bars associated with localized spalling tended to have an concrete clear cover of less than 1 inch. The observed deterioration was attributed to corrosion of the reinforcing bars, which has been accelerated by the saline environment.

- Corrosion staining, spalling, and previous patching were observed on concrete pile caps. Extensive spalling was noted at the corners of the four waterfront pile caps (Figure 492 and Figure 493). Previous patches and repairs as well as corrosion staining were observed along the edges and corners (Figure 494). The deterioration was attributed to physical impact caused by water vessels entering the boat slip and to corrosion of rebar.

FIGURE 491. Exposed reinforcing bar on underside of concrete pier.

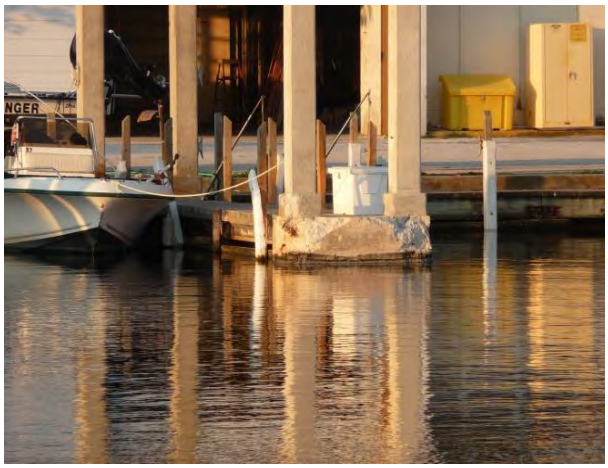

FIGURE 492. Spalling of waterfront concrete pile caps.

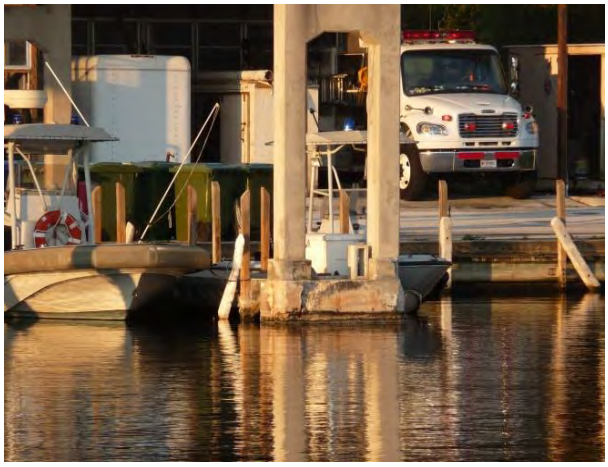

FIGURE 493. Spalling of waterfront concrete pile caps.

FIGURE 494. Concrete patch of a spalled pile cap.

- Corrosion staining was observed on the underside of the roof overhang and indicates corrosion of the reinforcing bar (Figure 495). Minor corrosion staining was observed on the galvanized flashing along the edge of the concrete roof slab (Figure 496).

- Extensive mold and algae growth was observed along the face of piers and on the tapered ends of the concrete girders (Figure 497 and Figure 498). In many instances, the organic growth was associated with the path of moisture run-off from the roof.

- Insect nests were observed on the underside of the double-T beams (refer to Figure 487).

FIGURE 495. Corrosion staining at the underside of the roof overhang.

FIGURE 496. Corrosion staining at the corner of the galvanized metal fascia.

FIGURE 497. Mold and algae growth patterns follow moisture run-off paths.

FIGURE 498. Algae on concrete pier.

Administrative Housing Units

Currently there are eleven buildings extant on site that house National Park Service and concessionaire employees. Three of these structures, building 416, building 439, and building 440, were constructed in the 1950s and 1960s as part of the Mission 66 program.

Building 416

Exterior Description

Located approximately 150 feet north of Florida Bay, building 416 is a two-story concrete structure with a flat roof and aluminum-framed doors and windows. This building contains four housing units on the second level, one of which is currently used as a physical fitness center by the National Park Service.

The entrances to each of the four units are visible from the front (north) elevation. building 416 is composed of two offset sections that are nearly identical in appearance. The east section of the building sits ten feet to the north of the adjacent west section (Figure 499). A concrete stair with aluminum railings is centered on each section of the north elevation (Figure 500). The concrete stair has treads that cantilever from a centered stringer beam. Flanking the central stair are original porches, now enclosed by insect screening, that extend north from the building (Figure 501). A sheet-metal panel closes off the screen wall at the top of the porch. A pair of double-hung windows and one door are present on the exterior wall inside the screen porch (Figure 502).

The existing windows are not original and consist of aluminum double-hung units with insulating glazing. Exterior-mounted non-original aluminum accordion hurricane shutters supported on top and bottom tracks are present at most window openings. An exception is the front elevation windows outside the porches, which have surface-mounted tracks that allow solid metal panels to be installed over the openings.

The roof membrane surface was not visible for survey during the field work for this project. The roof edge is formed by a painted wood fascia and a sheet-metal gravel stop; these elements are indicated on the construction drawings for the building and may be original. The original plans call for the roof to be sloped to two area drains, one each at the dividing wall between the bathrooms in each half of the building. Additionally, a gutter has been added to the front elevation only, with returns at either end to a downspout aligned to the first structural column (refer to Figure 499). The gutter is continuous the full width of the east elevation, but stops at the downspout location on the west elevation.

FIGURE 499. North elevation of building 416. At the left side of this view, note the downspout at the first structural column.

FIGURE 500. Concrete stairs at north elevation.

FIGURE 501. Screen porches flank the center stairs. Note the vertical siding at the second floor level and the aluminum-framed windows above the stairs.

FIGURE 502. Windows and main entrance are located on the north elevation and accessed from the screen porch.

The ground level of the building is largely open, with the exception of the area directly behind each stair, which is enclosed by a windowless concrete block wall. Above the ground floor enclosure, the second level of the north elevation is covered with painted vertical wood siding (refer to Figure 501). A grid of four rows of four structural concrete columns at each section defines the ground floor level and supports the second level of the building. The columns are painted brown.

Two windows are located at the second floor north elevation over the stairs and adjacent to the screen porch. The offset of the building masses creates a west-facing return wall at the center of the north elevation; this wall consists of windowless concrete block masonry at the second floor level.

The east elevation of building 416 consists of four concrete columns on the ground level and a concrete block wall on the second level (Figure 503). A porch space on the south side of the elevation has been filled in with vertical wood siding. A double-hung window is located at the southern end of this elevation (Figure 504).

FIGURE 503. East elevation.

FIGURE 504. Detail of east elevation window with shutter.