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February 16, 2016
2016009

Ms. Brenda Navellier
Kensington Fire Protection District
217 Arlington Ave.
Kensington, CA 94707

RE: Seismic Assessment
Kensington Police & Fire Station
215/217 Arlington Ave.
Kensington, CA 94707

Dear Ms. Navellier:

At your request, Biggs Cardosa Associates has performed a limited structural evaluation of the above referenced building. The purpose of this evaluation was to perform a visual assessment of the existing structural framing and prepare a letter report summarizing the results of our evaluation.

This assessment was based on limited visual observations of the exposed structural framing, the age, type and condition of the framing, engineering judgment, experience obtained from the evaluation and retrofitting of similar structures and a cursory review of the following original and remodeled design drawings, calculations and reports:

- Original drawings prepared by Jeffries Lyons and Hill, dated 09/19/1969.
- Renovation drawings prepared by Marcy Li. Wong and The Crosby Group, dated 09/10/1998.
- Structural calculations by The Crosby Group, dated September 1998.
- Renovation drawings prepared by Italo A. Calpestri III and Baseline Engineering, dated 06/21/2004.
- Structural calculations by Baseline Engineering dated July 27, 2004.
- Foundation repair drawings prepared by Biggs Cardosa Associates, dated 06/22/2009.
- Soils report prepared by Woodward-Clyde and Associates, dated May 28, 1969.
- Soils report prepared by Seidelman Associates, dated 06/8/1990.
- Soils report prepared by Geomatrix, dated October 1997.
- Soils report prepared by Kleinfelder, dated May 5, 2009.

No finishes, either inside or outside of the building were removed as part of this evaluation and no physical testing of the existing construction material were performed. It should be noted that only the structural calculations for the 1998 and 2004 remodel were available for review. The structural calculations for the original building were not available and the 2009 Biggs Cardosa Associates work was to correct a foundation settlement and sliding problem at the front of the

building. It should be noted that no additional calculations were prepared for this assessment. It should also be noted that because of the limitations of this evaluation, there could be concealed structural deficiencies. This evaluation did not include a soils' investigation or a review of the site work, architectural features, roofing material, along with any of the mechanical, electrical or plumbing systems.

Normal care has been taken in providing the professional opinions in this evaluation; however because of the limitations of this evaluation, no guarantees or warranties are expressed or implied.

DESCRIPTION OF THE EXISTING BUILDING

This building is a 24/7, two-story police and fire station, which was constructed on a slopping site in 1969. Because of the slopping site, the ground floor level has a partial basement located at the rear of the building. In 1998 the building was architecturally remodeled. This remodeling included a partial seismic upgrade of the structural framing per the 1995 California Building Code. In 2004 some additional architectural remodeling and partial seismic upgrading based on the 2001 California Building Code was performed. To correct a small amount of sliding and settlement of the foundation and exterior wall located on the west or downhill side of the building, drilled reinforced concrete piers to support the foundation were added in 2009.

At the ground floor level, the station has three apparatus bays, fire equipment storage areas, a public entrance, reception area, police and fire department office spaces, interview room, evidence storage, general storage, training room, kitchenette, restroom, and stairs for access to the second floor. At the second floor level the station has a reception area, office spaces, restrooms, restrooms with showers, locker rooms, squad rooms, sleeping quarters, dayroom, kitchen, outside roof deck, mechanical and storage rooms.

DESCRIPTION OF THE EXISTING STRUCTURE

The station is a two story 5,800 square foot wood framed structure constructed on a sloping hill side lot. The building has a relatively simple framing system. Because of the sloping site the ground floor has a partial basement at the rear of the building while the front of the building is open to the street. The top of most of the 2nd floor is 11'-9" above the ground floor slab while a small portion of the 2nd floor and an outside roof deck partially located over the apparatus bays is 2 feet higher at 13'-9". The average elevation of the sloping roof is typically 22'-9". The roof over small clearstory penthouse is located at an elevation of 26'-0".

Built up roofing is installed over ½" plywood sheathing which spans between 2x8 joists spaced at 16 inches on center. The slope of the roof is produced by using ripped 2x6s over the 2x8 joists. The joists, which span a maximum of 16'-6", are typically supported on 2x4 stud bearing

walls but when open spans are required wood or steel beams are used. At the 2nd floor level, the wood and steel roof beams are supported on wood columns.

The second floor is framed with ¾" plywood sheathing installed over either 2x10 or 2x14 floor joists spaced at 16 inches on center. The floor joists, which span a maximum of 15'-8", are typically supported on 2x4 stud bearing walls but when large open spans are required wood or steel beams are used. At the ground floor level the wood and steel floor beams are supported on other steel beams, wood columns, steel columns or the concrete basement retaining wall at the back of the building.

At the ground floor, the wood stud walls and all 2nd floor beam columns are supported on continuous reinforced concrete footings. In a couple of locations the continuous footings have been widened for heavier column loads. Since the ground floor is partially cut into a sloping hillside the rear and a portion of the side walls are constructed with "L" shaped reinforced concrete basement retaining walls. Four areaways are located on one portion of the rear basement retaining wall to let light and air into the adjacent rooms. The ground floor in the apparatus bays is constructed with a 7 inch reinforced concrete slab while the ground floor in the remaining areas of the building has a 4 inch reinforced concrete slab. Six reinforced concrete drilled piers were installed in 2009 to correct a settlement and sliding problem at the front wall and the foundation in office portion of the building,

The building was originally designed to resist both wind and seismic loads using the plywood sheathing at the roof and 2nd floor as the horizontal diaphragms. All ground and second floor exterior walls and the interior common wall between the office areas and the apparatus bays have plywood sheathing as the vertical shear walls.

Our preliminary review of the drawings indicates that this building has continuous load paths for both gravity and lateral loads. In 1998 the building was remodeled and portions of the structure were seismically upgraded. This seismic upgrade included adding holdowns at the ground floor and 2nd floor levels at the interior common wall. To eliminate the soft story at the apparatus bay openings a three bay steel rigid frame in drilled reinforced concrete piers was added along with a continuous collector at the second floor level. In 2004 the building was again remodeled and some additional seismic strengthening was performed. The steel rigid frame installed during the 1998 remodeling was strengthened to meet the requirements of the 2001 CBC and additional plywood sheathing was added to the other side of the shear wall at the common wall between the office space and the apparatus bays. However, like the 1998 remodel, the 2004 seismic strengthening was only a partial upgrade.

OBSERVATIONS OF THE EXISTING STRUCTURE

On Tuesday, January 26, 2016, our office performed a limited visual structural survey of the existing building. The following items were observed:

- Some cracks in a few locations at the interior gypsum board walls were observed. The interior of the station had been recently painted.
- We were informed that the slope in the floor slab along the front wall in the office area that was originally caused by the settlement and sliding of the front foundation has not worsened since the installation of the drilled piers in 2009.
- Cracks in the apparatus bay floor slab were observed.
- The door to Office 1 at the second floor was out of plumb in the plane of the door. Since there were no cracks in the gypsum board at the perimeter of the door it seems that the door was poorly installed and needs to be re-hung.
- A relatively large crack in the concrete curb and the top of the retaining wall located at the southwest corner of the outside accessibility ramp at the front entrance to the station was observed.
- Some cracks in the sloping asphalt pavement of the driveway leading up to the parking lot at the back of the station were observed.

DISCUSSION OF SEISMIC DESIGN CRITERIA

The original drawings indicate that the building was designed and constructed in 1969 and therefore was probably designed to meet the minimum requirements of the 1967 Uniform Building Code. In the 1998 and 2004 projects the building was remodeled and some portions of the structure were seismically upgraded. The original design calculations for these two remodel projects indicate that the areas directly affected by the remodeling were seismically upgraded to the newer codes, therefore only a partial seismic upgrade to meet the 1995 and 2001 California Building Code requirements was performed. It is a reasonable assumption that the seismic upgrades of the items indicated on the drawings met the requirements of the newer codes. The 2009 project was to control and repair the settlement and sliding of the front wall of the building, seismic evaluation and required strengthening was not included in the scope-of-work.

Over the years there have been many changes in the Uniform and California Building Codes regarding the minimum requirements for the structural design of a building. These changes have affected both gravity and lateral loads. These minimum design loads have increased in magnitude as more information has become available about how structures respond to different loads and as analysis techniques have become more sophisticated. The increase in the structural design requirements has created buildings that can better resist both gravity and lateral loads, thus making the new buildings safer.

Before 1934, the Building Code did not require structures to be designed to resist the lateral loads generated by earthquakes. After the 1933 Long Beach Earthquake, the State Legislature enacted a requirement of minimum seismic design standards in the structural design of all new buildings.

Another way in which the more recent codes have improved the safety of newer structures is by the increase in the numbers and types of inspections required during construction. These inspections include standard testing for all types of construction materials, i.e., concrete, wood, steel, etc. The building industry along with the increasing Code requirements has advanced the safety of newer structures by improving the methods, procedures and quality control of the actual construction.
Since the minimum design requirements have increased over the years, most buildings designed and constructed before the more recent Codes will probably not meet all of the latest seismic requirements. These older buildings probably do not include any of the new structural details required to resist earthquake forces. Since most old buildings do not meet the new seismic requirements, they probably will not perform as well during an earthquake.

There are many factors that affect how a building will respond during an earthquake. These factors have been reduced to the following six primary items:

1. Earthquake type (magnitude and period) and the distance of the building from the epicenter
2. Soil and site conditions.
3. Building size and configuration
4. Quality of engineering design
5. Quality of building material and construction
6. Age, prior building alterations and the existing condition of building

One way to understand how the existing buildings perform during an earthquake is to evaluate the damage to the structures after a quake. The following are typical structural failures, which have been observed in similar older buildings:

1. Walls pulling way from floors and roofs
2. Displacement and/or buckling of floor and roof system
3. Displacements or collapse of walls
4. Failure of the connections of structural elements

Since the building was designed and constructed to meet the requirements of the 1967 Uniform Building Code, it is our opinion that this structure will not meet the seismic requirements of the latest codes and therefore this building has a higher level of potential life safety hazards.

UNIFORM BUILDING CODE - SEISMIC DESIGN CRITERIA

One simple way to evaluate the seismic design level of an existing building is to compare the minimum base shear (seismic design force) requirements of the code that the building was originally designed to that of a new building. It should be noted that both police and fire stations are essential facilities and require immediate occupancy after a seismic event. The more recent codes require that police and fire stations be designed with an importance factor that increases the seismic design forces to a higher level than other buildings. More recent codes have also modified the allowable strength values that the engineer can use in the design of structures.

The base shear or seismic design forces is calculated as a percentage of the total weight of the building acting laterally. The code gives the engineer an approved method to calculate the percentage of building weight to be used in the design of the structure. As stated earlier, over the years the factors used to calculate the base shear have been modified as engineers have learned how structures perform during an earthquake. Some of the factors include the type of structure, size and height, distance to known earthquake faults, etc.

The following is a comparison of the seismic design requirements for the base shear of the 1967 Uniform Building Code to that of the 2013 California Building Code for the same type of building framing system. The 1967 Uniform Building Code required that 13.3 percent of the building weight be used as the lateral seismic load to design the building, while the 2013 California Building Code now requires that 26.0 percent of the building weight be used. The seismic design forces have substantially increased since the station was originally built. If the existing police and fire station were to be designed today, the new code would require that it would be designed for approximately twice the seismic forces as the original station.

However, during the 1998 and 2001station remodeling projects some of the structural elements of this building were seismically upgraded. These partial seismic upgrades were based on the newer code requirements and therefore will increase the ability of the structure to resist seismic loads. These seismic upgrades have increased the life safety potential of the station.

EARTHQUAKE FAULTS

Our review of the geotechnical reports for the building site points out that this site is located within the State of California Earthquake Fault Study Zone, which means that this site is in a region of high seismic activity. The geotechnical reports indicate that the following active faults are within close proximity of the station:

1. The main trace of Hayward Fault passes approximately 300 to 400 feet west of Arlington Avenue.

2. San Andreas Fault is located approximately19 miles southwest of the site.
3. Rodgers Creek-Healdsburg Fault is located approximately 12.5 miles north of the site.
4. Calaveras Fault is located approximately18 miles east-southeast of the site.

STRUCTURAL DEFICIENCIES AND DAMAGE

As previously discussed in this report, recent codes have substantially increased the minimum loads and forces to be used in the design of buildings. These newer codes have also required that stronger connections be used in the design and construction of buildings. Based on the age of the building, the type and condition of the existing framing, engineering judgment, experience obtained from evaluating similar buildings, and since the minimum design forces have increased along with the requiring stronger connections; in our opinion the following existing structural elements are probably deficient:

- The plywood floor and roof diaphragm
- The connection of the plywood floor and roof diaphragm to the shear walls
- The plywood shear walls
- The anchorage of the plywood shear walls to the foundation
- Foundations

CONCLUSIONS AND RECOMMENDATIONS OF EXISTING STRUCTURE

Although no major signs of distress or damage were observed, the noted deficiencies do indicate that the structure is vulnerable to seismic loading. The building has been well maintained over the years. Minor cracks in the interior gypsum board walls were observed. No settlements in the existing basement retaining walls or building foundations were observed. No cracks or damage to the exterior finishes were observed. Cracks in the apparatus floor slab were observed but due to the age of the slab and the heavy loading of the fire trucks these cracks are normal and are to be expected.

The building does not meet the requirements of the newer codes and as a Police and Fire Station; it is an essential facility and therefore is required by code to have immediate occupancy after an earthquake. When the building was originally designed there were no special design requirements for this type of building. However, later codes recognize that this type of facility must allow for continuous operation after an earthquake. Because the station is located in a very active seismic zone, the code requires that higher seismic forces be used in the design of the building. These higher seismic design code forces for this location are approximately two times the seismic forces used in the design for the original building in 1969.

On two occasions the station has had partial seismic upgrades performed during architectural remodeling projects. These seismic upgrades have improved the ability of the building to resist earthquakes forces but since they were only partial upgrades, it is our opinion that the building still does not meet the requirements of the newer codes. This building, because of its age and the newer code requirements, does have structural deficiencies and will not perform as well as a new building during an earthquake. Because the building does not meet the latest seismic code requirements and due to its proximity to major earthquake faults there is the possibility that significant structural damage may occur with loss of life during a seismic event.

We recommend that the existing building be replaced or fully evaluated based on the requirements of the 2013 California Building Code by a registered Structural Engineer to determine the structural framing elements that are deficient. Please note that a replaced structure would not only perform better during an earthquake but address many of operational issues of the existing station.

If you have any questions or require additional information please give us a call. We can meet at your convenience to discuss this report and how we can further assist you.

Sincerely,

BIGGS CARDOSA
ASSOCIATES, INC.

Mahvash M. Harms, S.E.
Principal

cc: Don Dommer, Don Dommer Associates, Inc.
Dennes J Furia, Biggs Cardosa Associates, Inc.