Project Report

Structural Investigations
Hotel del Sol
Yuma, Arizona

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1.0 INTRODUCTION

At the request of Principle Engineering Group, Atkinson-Noland & Associates (ANA) was retained to conduct an evaluation and condition survey of the Hotel Del Sol located at East 3rd St. and Gila St. in downtown Yuma, Arizona. The building will be retrofitted to house a transportation hub for the city and provide office space on the upper floors. The building has been abandoned for a number of years and currently has no functioning electrical or plumbing system.

The evaluation was conducted by ANA engineers David Woodham and Shan Wo, on October 8th though 11th, 2007. The evaluation consisted of visual observations and measurements of the structural elements of the hotel. Core samples of the concrete exterior walls were obtained for determining the compressive strength of the concrete. A condition survey was conducted on the exterior of the building noting the locations of cracks or other anomalies.

1.1 Background

The historic Hotel del Sol was constructed in 1926 at 300 S. Gila St. in downtown Yuma, Arizona. Originally called the Hotel Del Ming after the hotel manager and then mayor of Yuma, the hotel was well located across the street from the Yuma rail station. The hotel has had many owners over the years but has been largely unoccupied since 1988. The exterior walls and the ground floor walls that form the arcade are constructed of reinforced concrete. The arched concrete façade on the north and east elevations transitions to wood framing with applied stucco on the second and third floors. The second floor is typically wood framed, supported on steel or concrete beams. The third floor and roof are wood framed.

2.0 PROJECT OBJECTIVES

The objectives of the investigation were to determine the as-built conditions including information on major structural elements such as typical floor framing, wall framing/thickness, and any structural columns or beams. In addition, an on-site condition survey was conducted documenting observable distress on elevation drawings.

2.1 Approach

The techniques used were primarily visual, supplemented by use of an eddy-current pachometer to locate steel embedded in concrete cross sections. Probes were made at approximately 25 locations to determine the size of steel cross sections, the direction of framing elements, and the size and configuration of steel reinforcing in concrete cross sections.

3.0 RESULTS

3.1 General Observations

The Hotel Del Sol is constructed with concrete exterior walls with wood walls used to frame the interior and outer breezeway walls above the first floor level. Large spans are accomplished though steel columns and beams on structural grid lines. Secondary floor and roof framing is timber.

The hotel is in relatively good condition structurally with few cracks observed in the structural concrete. Structural steel appears to be in good condition with no visible corrosion in the limited areas investigated. Timber framing is in acceptable condition except in very limited areas where localized moisture and fire damage have affected the wood.

3.2 Investigation Results

3.2.1 Framing

Framing direction and type were determined by visual observations where possible. In many locations, small openings were made in the plaster and metal lathe covering the framing member in order to facilitate measurements. The framing for the second floor (floor level) is a hybrid system of steel beams supported on steel columns, concrete beams supported on concrete columns, concrete bearing walls, timber bearing walls, and timber floor joists spanning between the structural beams. The third floor (floor level), ceiling, and roof are framed with timber.

The exterior walls consist of 12 inch thick reinforced concrete walls at the ground floor. The walls generally have an inch of plaster on each face resulting in a gross wall thickness of 14 inches. These walls remain 12 inches thick on the second floor, reducing to 8 inches thickness for the 3rd floor and roof-top parapet walls.

Drawings 1 and 2 depict what is known about the second floor framing system and steel columns supporting the second floor. Some areas were not investigated due to lack of access or covered by the original finishes in the lobby of the hotel.

Figure 1. Concrete beam at Gridline 4 at south exterior wall. This beam supports the concrete walls on the second and third floors. Note bearing location above window head at exterior concrete wall.

Figure 2. Plaster and lathe removed from column base to expose steel cross section for measurements.

Figure 3. Top of column and end of beam visible in opening. Most connections are riveted, however bolted connections were also observed.


Figure 4. View from below of typical beam supporting second floor wood framing.

The wood joists on the second floor are typically 2” x 10” at 16 inches on center. The exception is the framing over the hotel lobby near the northeast corner. The framing here consists of 3” x 10” members at 12 inches on center from which the dropped ceiling and faux beams for the lobby are suspended.

The wood framing on the third floor follows a similar pattern with 2” x 10” wood framing at 16 inches on center. The ceiling on the third is framed in the same way. The roof is overframed with 2” x 6” framing at 24 inches on center.

3.2.2 Reinforcing Investigations

Typical reinforcing within the exterior concrete walls was located with an eddy-current pachometer. There is typically a vertical reinforcing bar at the jamb of each opening. For larger piers, typical vertical reinforcing is one bar every 24 inches. The size of the bars and lap condition are unknown at this time.

The thickened wall sections at column lines were investigated and found to contain a reinforcing bar at each corner of the cross section. A probe at one column indicated the column is reinforced with four ¾ inch square, deformed bars. Figure 5 shows the location and condition of the exposed bar.

Figure 5. Exposed reinforcing bar in corner of concrete column

3.2.3 Concrete Testing

As concrete testing could not be arranged while Atkinson-Noland was on site, core locations were determined for coring during the following week. Nine core locations were identified – three from each floor at random locations around the hotel. Each core location was scanned with an eddy-current pachometer to avoid cutting reinforcing steel.

The cores were tested in compression by Geotechnical Testing Services of Yuma, Arizona, according to ASTM C39/C39M-05, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*.

Table 1. Concrete core compression test results.

Core ID	1	2	3	4	5	6	7	8	9
Area (in^2)	11.04	11.04	11.04	11.04	11.04	11.04	11.04	11.04	11.04
Load (lbs)	30245	33540	18485	26130	25770	24385	41625	34955	38445
Strength (psi)	2740	3040	1670*	2370	2330	2080	3510	3040	3270

Core #3 reportedly contained a clay ball within the core.

Based on the reported results, the average compressive strength of the 9 cores is 2670 psi, with a standard deviation of 600 psi. The coefficient of variation is approximately 23%. If the results of core #3 are removed from the data set, the average compressive strength is computed as 2800 psi, the standard deviation is 500 psi, and the coefficient of variation is slightly lower at 18%. The compressive strength of 2800 psi is not uncommon in buildings of this era and construction type. The adequacy of the concrete strength can only be determined following analysis of the code-mandated loads imposed on the structure.

3.2.4 Condition Survey

A condition survey of the exterior walls of the Hotel del Sol was conducted from ground level, the sleeping porches, and the roof using visual methods. All cracks, spalls, delaminated plaster, and cold joints between concrete pours were noted on elevation drawings. The condition survey drawings are contained in Appendix A. In general, the building is good condition for the age of the structure.

Figure 6. Typical cold joint (west elevation of west light well) as found on most elevations. The interface between successive concrete pours is not well consolidated.

The hotel has been through a number of seismic events including a Class IV* earthquake (Modified Mercalli Intensity Scale) in 1927, shortly after the building was completed. Other Class IV earthquakes occurred in 1931, 1932, 1975, and 1976. A class V earthquake** occurred in 1953. More recently, the structure was subjected to Richter magnitude 3.2 and 3.8 earthquakes in 1989 and 1999. The building does not display typical earthquake damage.

*IV. Most people indoors feel movement. Hanging objects swing. Dishes, windows, and doors rattle. The earthquake feels like a heavy truck hitting the walls. A few people outdoors may feel movement. Parked cars rock.

**V. Almost everyone feels movement. Sleeping people are awakened. Doors swing open or close. Dishes are broken. Pictures on the wall move. Small objects move or are turned over. Trees might shake. Liquids might spill out of open containers.

4.0 CONCLUSIONS AND RECOMMENDATIONS

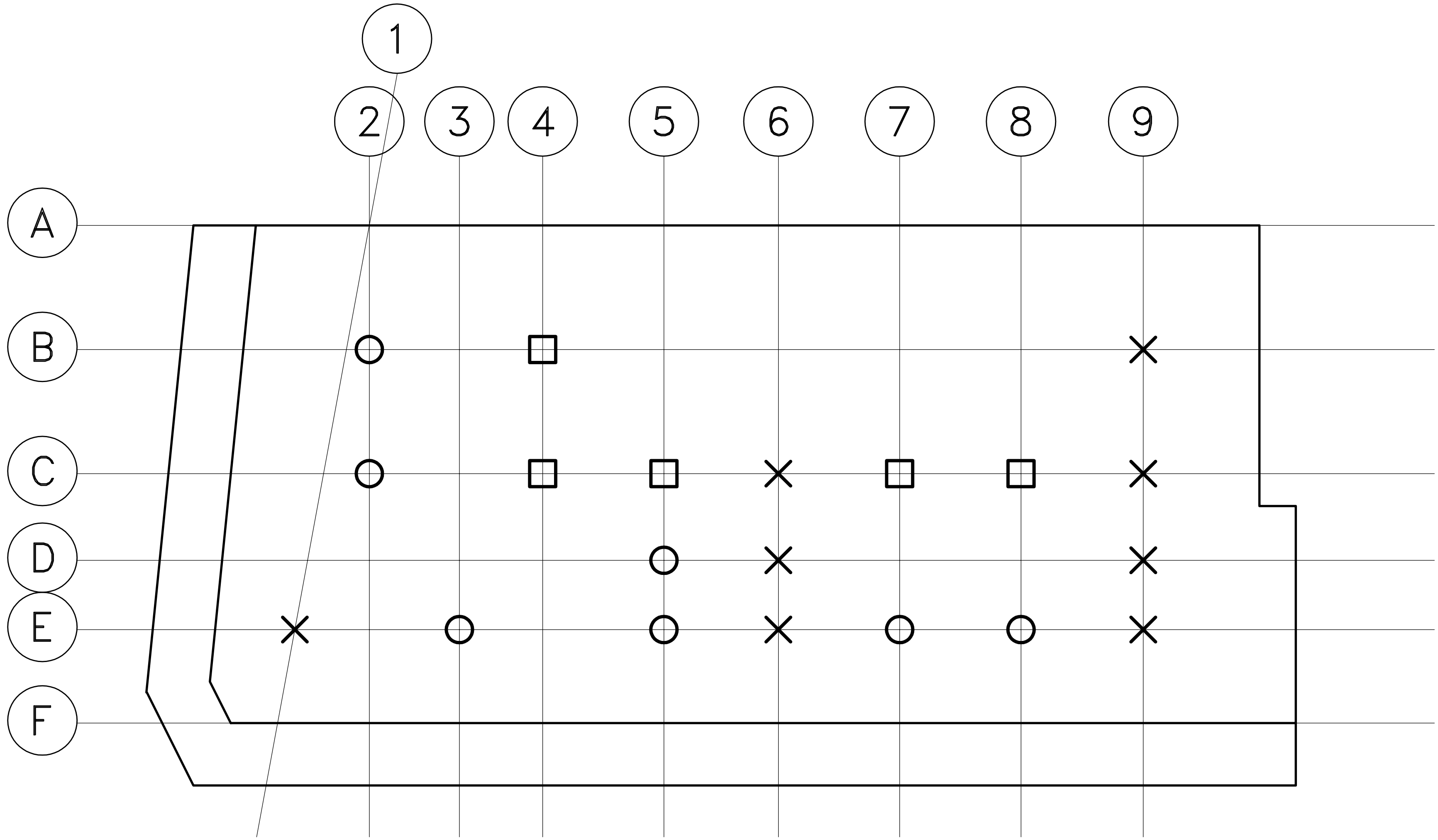
This investigation determined the majority of the steel cross sections framing the second floor and the remaining timber elements that support the sleeping porches, second and third floors, and roof. The building is in relatively good condition structurally for the age of the hotel. A condition survey was done documenting the current areas with observable distress.

The average compressive strength of the concrete is approximately 2800 psi based on 8 samples tested. Recommendations of the American Concrete Institute (ACI) should be followed to arrive at suitable values for design purposes. Vertical steel reinforcing is present in the areas investigated. Additional investigations are needed to verify the size of vertical reinforcing and determine the presence and size of horizontal steel reinforcing over window heads and in the large concrete beams at the light well walls.

The concrete beams at Gridline C (Gridline 4 to 5 and 7 to 8) and Gridline 4 (Gridline A to C) support concrete walls on the 2nd and 3rd floors as well as the floor and roof dead and live loads framing into them. It is unknown, at this time, how these beams are configured. Steel angles are visible along the lower corners of the beams, but it is unknown if these are composite with the beam via shear studs or are non-composite with the concrete. The design intent may have been that these are deep beams incorporating the walls on the second floor (below the windows) as part of the compression portion of the beam. Additional investigations are needed to resolve the configuration of these beams and establish the steel layout at the bottom of the beam and over supports. This can be done with microwave radar with selective openings to determine the bar sizes. Since the City of Yuma is in Seismic Design Category D, understanding this area is critical to a successful seismic retrofit.

Various spalls, cracks, delaminations, and cold joints are evident on the exterior of the Hotel del Sol. These should be addressed during the renovation of the hotel. Proper preparation of the substrate and patching with compatible cementitious materials will reduce moisture infiltration and protect the reinforcing steel.

Appendix A
Project Drawings



1/2 Column Plan 1st Floor

SCALE: N.T.S.

NORTH

KEY

- ○ 8x8 Steel Column
- × 6x6 Steel Column
- □ 16x16 Concrete Column

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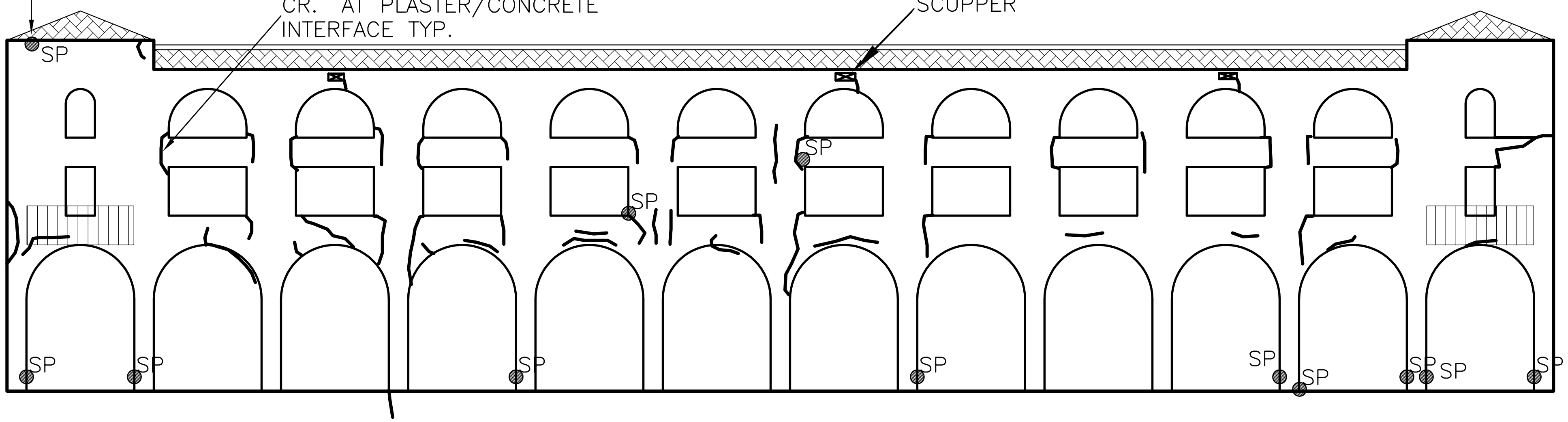
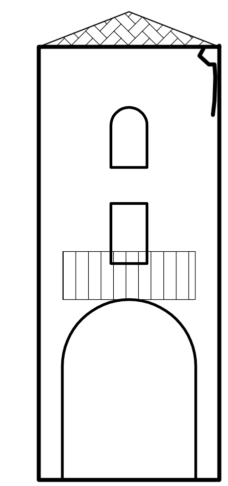
Del Sol Hotel
Yuma, AZ

SCALE: AS SHOWN	JOB NO. 07–121	PAGE 2



1 / 1 North Elevation

Scale: 1/16" = 1'–0"



2 / 1 Northeast Elevation

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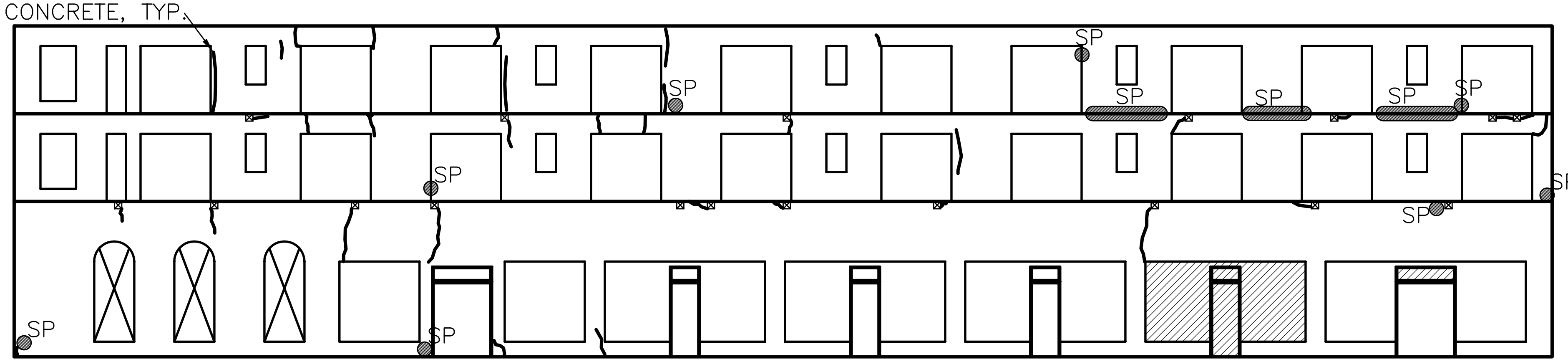
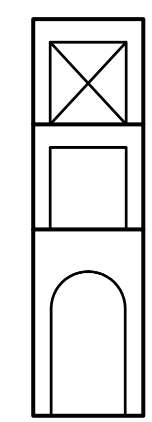


3 / 1 North Elevation

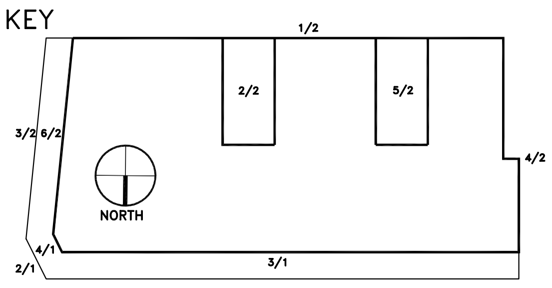
Scale: 1/16" = 1'–0"



4 / 1 Northeast Elevation

Scale: 1/16" = 1'–0"

KEY



KEY

CR CRACK
SP SPALL
CRACK

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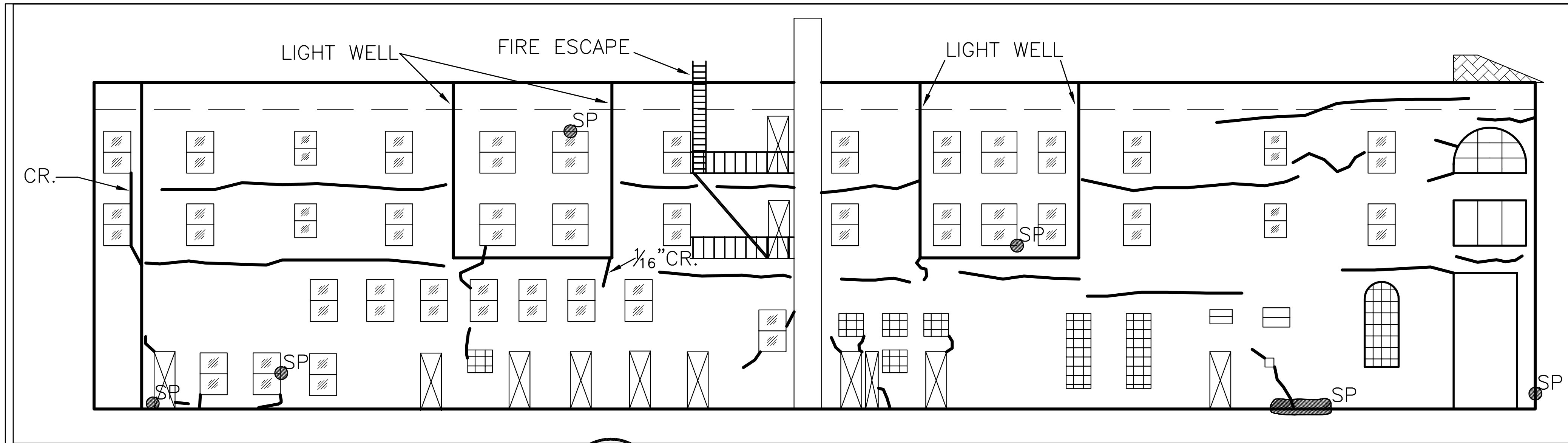
Del Sol Hotel
Yuma, AZ
Condition Survey

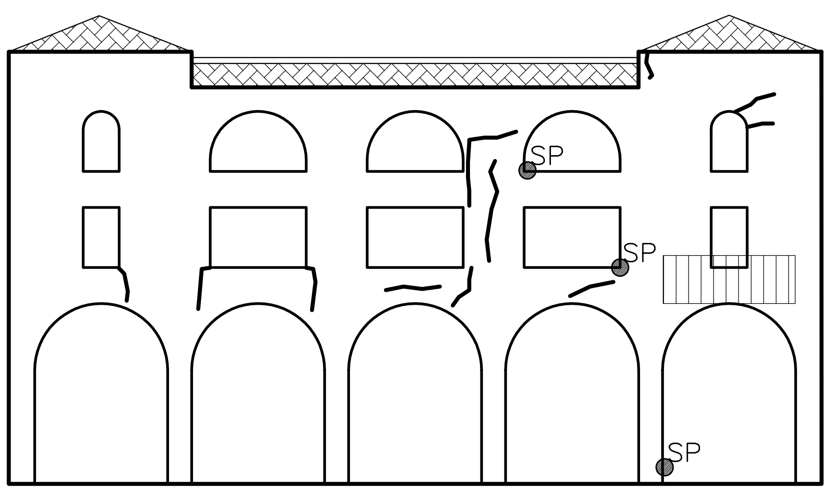
SCALE: AS NOTED
JOB NO. 07–121
SHEET:

S1



1/2 South Elevation

Scale: 1/16" = 1'-0"



3/2 East Elevation

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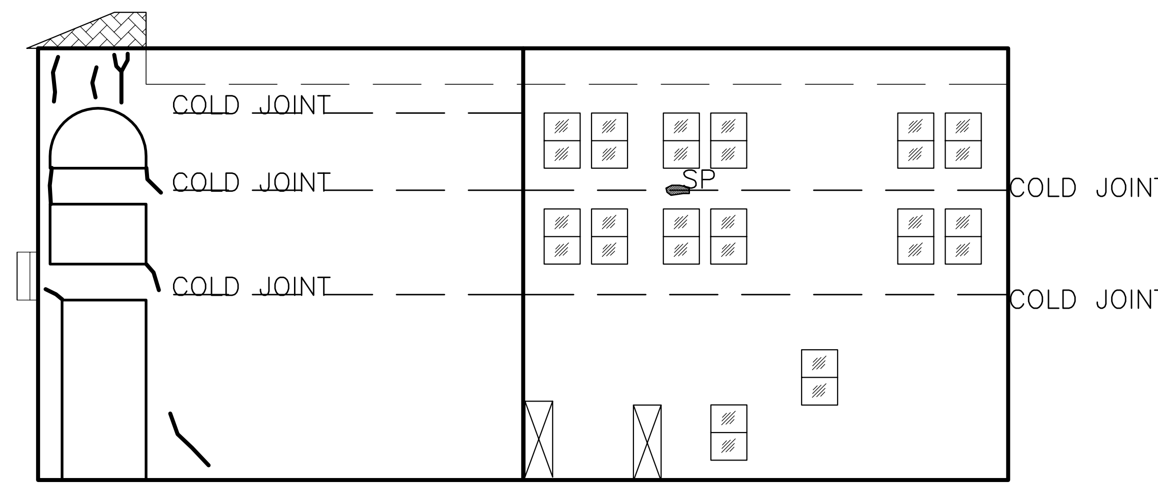

4/2 West Elevation

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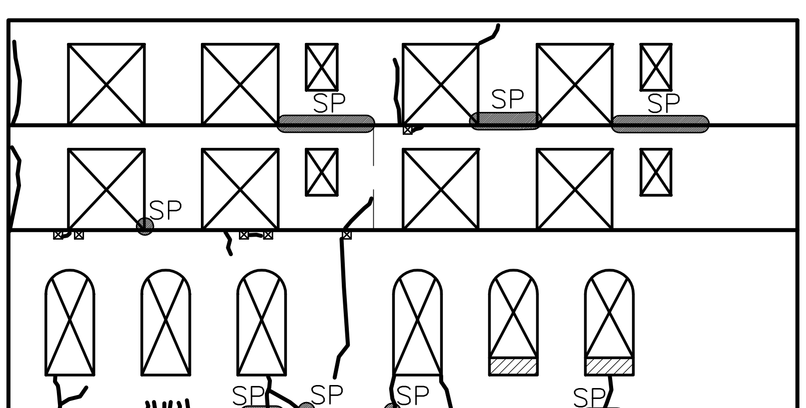
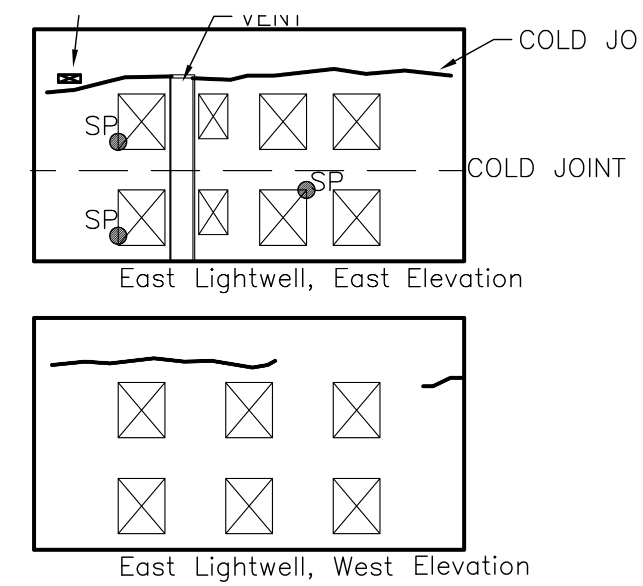


6/2 East Elevation

Scale: 1/16" = 1'-0"

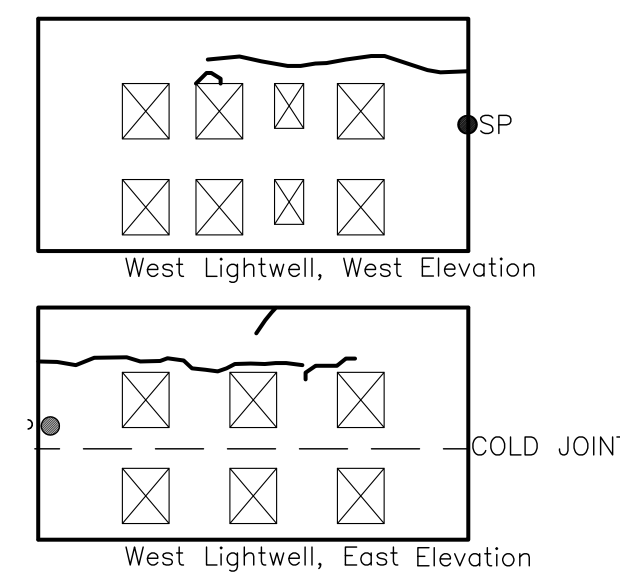
KEY

SP SPALL
CR CRACK
CRACK
SPALL



2/2 East Lightwell Elevations

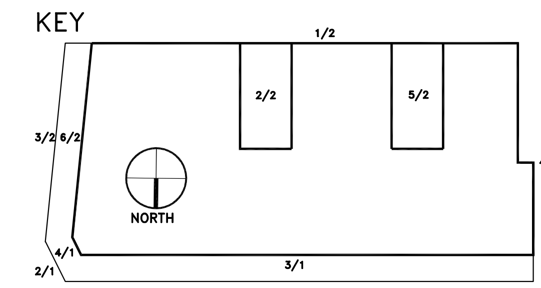
Scale: 1/16" = 1'-0"



5/2 West Lightwell Elevations

Scale: 1/16" = 1'-0"

KEY



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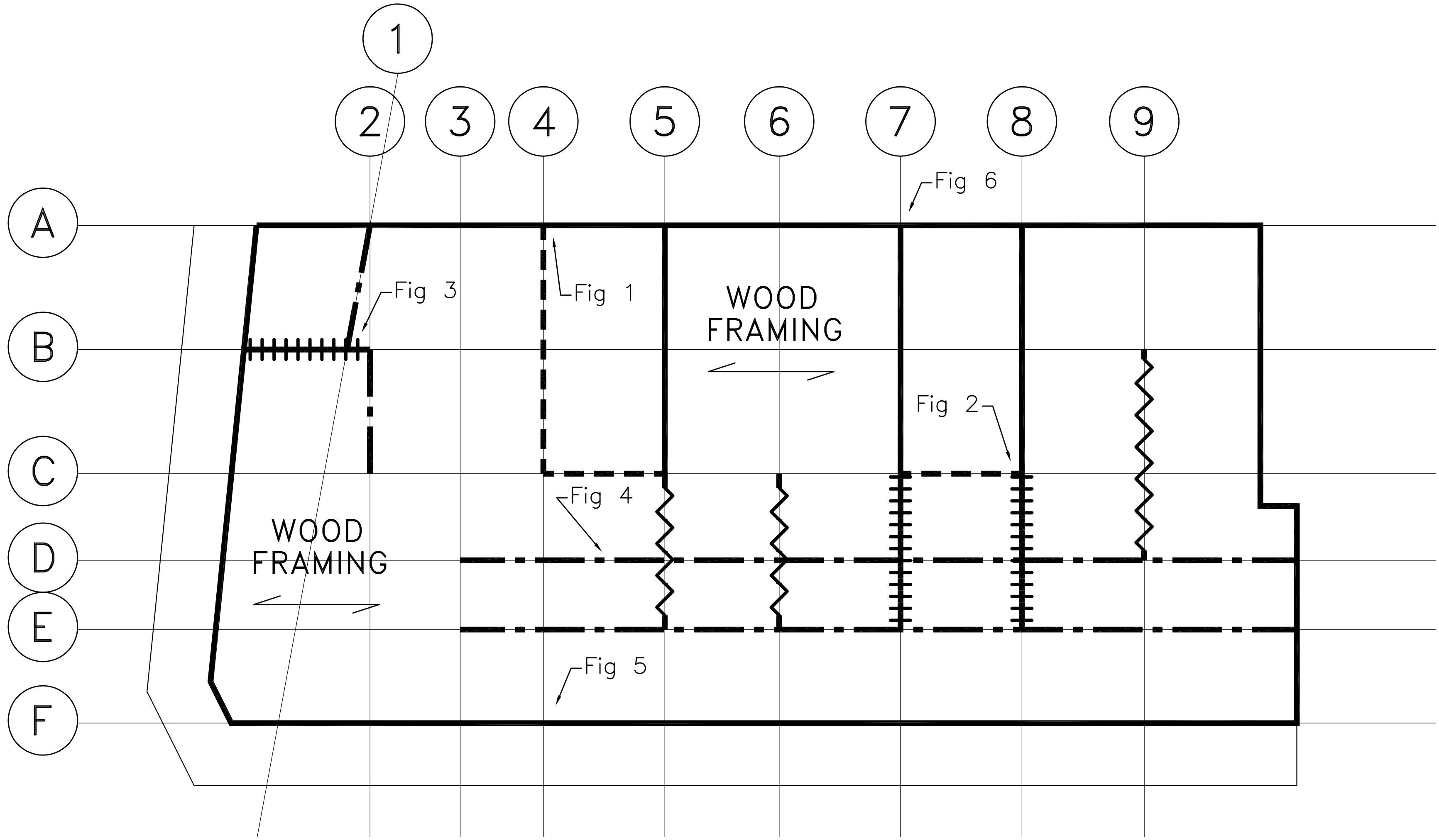
JOB NO. 07–121
SHEET:

S2



Framing Plan 1st Floor

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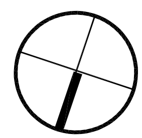

KEY

- Concrete
- Concrete Beam
- 24" d
- 18" d
- 12" d

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