JELLY'S RESTAURANT

Pier 50, San Francisco

Proposed Partial Seismic Upgrade

SITE CONDITIONS

&

FOUNDATION RECOMMENDATIONS

LAWRENCE B. KARP CONSULTING ENGINEER

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CONSULTING GEOTECHNICAL ENGINEER

FOUNDATIONS, WALLS, PILES
UNDERPINNING, TIEBACKS
DEEP RETAINED EXCAVATIONS
SHORING & BULKHEADS
CEQA, EARTHWORK & SLOPES
CAISSONS, COFFERDAMS
COASTAL & MARINE STRUCTURES

SOIL MECHANICS, GEOLOGY
GROUNDWATER HYDROLOGY
CONCRETE TECHNOLOGY

May 9, 1999

Ricci Cornell
295 Terry Francois Boulevard
San Francisco, CA 94107

Subject: Jelly's at Pier 50, San Francisco
Proposed Partial Seismic Upgrade
Site Conditions & Recommendations

Dear Ms. Cornell:

As authorized, this letter-report provides geotechnical related recommendations for a partial seismic upgrade design of temporary and permanent construction of the subject project, based on a limited reconnaissance program, research, and review of published geotechnic literature and other available information. The project involves improvements to a building constructed before 1953.

Site

The site is situated at the edge of San Francisco Bay, about 1,100 feet south of China Basin and the Lefty O'Doul Bascule Bridge on Third Street that divides the Basin from the Channel. The building is founded on three different types of support: The outer (Bay side) one story portion is founded on a reinforced concrete pile supported wharf that was built in 1924 as a railroad approach to Pier 50; the outer (Bay side) two story portion is founded on the seawall apparently built in 1922; and the landward (Terry A. Francois Boulevard side) portion of the building, both one and two story, is founded in landfill (made from Rincon Hill sand and 1906 earthquake debris) placed between 1913 and 1923. At the time of the 1906 earthquake, the shoreline was near the foot of Fourth Street at Pier 54 where Third Street is now (Goldman [Steinbrugge] 1969).

On 4/15/99 a visual inspection by boat was made of the underside of the wharf. Generally, the concrete piles are in good condition but they may be of composite construction; below the mudline they are probably wood and above, formed concrete. The wharf deck is also in good condition, especially where the deck is especially heavy at the former location of the railroad tracks; the lighter deck has some corrosion of the steel reinforcing and associated leaching of calcium carbonate and spalling of concrete so some maintenance is required. At the outer edge of the wharf, between the Bay and the building, there are some wood fender piles and sawn lumber bracing that have completely deteriorated.

The seawall's construction is probably similar to the South Beach Harbor seawall, which was built in 1924 of rubble; large rocks and mixed soil and rock placed in a trench excavated in Bay Mud. Over the years, the rubble seawalls in San Francisco of the 1920s have usually reached equilibrium, however the backfill to the walls is somewhat unstable; ground is lost through the seawall by tidal action and landward drainage, and differential subsidence has occurred due to consolidation of the underlying Bay Mud and densification vibrations due to construction, traffic, and earthquakes.

100 TRES MESAS, ORINDA CA 94563 (925) 254-1222 fax: (925) 253-0101 e-mail: lbk@lbkarp.com

Geology

The site is at the northeastern edge of the San Francisco Peninsula, which is a northwest trending range of hills composed of a heterogeneous assemblage of folded, faulted and sheared rocks of the Franciscan Formation, Jurassic-Cretaceous age, about 165 million years old. Geologic maps (Schlocker et al 1958) indicate the site is underlain with artificial fill (***Qaf***); predominately dune sand but includes silt, clay, rock waste, manmade debris, and organic waste. The fill exists over Bay Mud[1] and was placed between the original shoreline and Mission Rock, which is at the end of Pier 50 (Mission Rock Terminal). The maps show Mission Rock to be undifferentiated sandstone and shale (***Kjs***).

Subsurface

The site (landward of the wharf and seawall) is blanketed by very loose to loose sand and gravel fill containing various amounts of silt, clay and rubble, estimated to be about 20 feet thick. In the vicinity of the Port of San Francisco's storage yard north of China Basin the fill is between 30 and 40 feet thick. The pier, and probably part of the land behind the seawall and wharf, is underlain by hydraulic fill[2] consisting of very loose to medium dense sand with various amounts of silt. Although most of the materials used in these filling operations are, in themselves, fairly sound, because little or no compaction was involved (other than that provided by gravity), much of the fill is loose and could not provide adequate support for foundation piles. Additionally, most of the fill is highly corrosive to untreated concrete and steel because of high chloride and sulfate concentrations in the soils used for fill. Bay Mud usually underlies the fill, however in some locations near the edge of the old shoreline, no Bay Mud was deposited, and the fill is underlain by weathered shale bedrock. Where Bay Mud was dredged for pier and bulkhead construction the fill is underlain by dense to very dense sand. The Bay Mud is 10 to 20 feet thick where it is present. Similar to the fill, Bay Mud is highly corrosive to untreated concrete and steel.

In the general area, below the Bay Mud is a sequence of alluvium (dense to very dense sand) and Old Bay Clay (stiff sandy clay) overlying weathered shale bedrock. The sedimentary (sand) sequence thickens to the east. Both the sedimentary sequence and the bedrock are strong enough to provide support for foundation piles that penetrate the Bay Mud. At the Jelly's site, bedrock is at the -150 foot contour (Schlocker 1961; Joyner 1982), so piles that derive their support from friction or end bearing in the sand may have been used or can be used in the remedial design.

Groundwater at the site may be expected at depths between 2 and 12 ft. below the ground surface. Depths, if a test excavation is made at the subsided column (see Recommendations), may appear to be anomalous because of a perched groundwater table over an impervious lens (clay); the general water table in the area is about is 10 to 12 feet below the ground surface. Even if clay lenses exist, the submerged loose granular materials could lead to liquefaction during seismic vibration.

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[1] Bay Mud is a layered sequence of soft, plastic, expansive sediments forming the bottom of San Francisco Bay, consisting of clay- and silt-sized particles interspersed with stringers and pockets of peat, fine sand, and minor amounts of gravel, and having a water content ranging between 30 and 92 percent (commonly 50 to 60 percent in the uppermost 50 to 100 feet of the deposit).

[2] Soil materials that have been excavated, transported, and flushed into place by moving water. Most hydraulic fills in tidal areas consist of silt and sand "vacuumed" from the floor of a bay by a suction dredge and pumped through hoses into areas enclosed by bulkheads or levees.

Seismicity

Environmental Setting

The site is located in the earthquake active San Francisco Bay Area which is seismically dominated by dextral horizontal shear movements resulting from the relative motion of the Pacific and North American plates, manifested by the presence of the San Andreas Fault System. In the theory of plate tectonics, the San Andreas is the boundary between the northward moving Pacific Plate (west of the fault) and the southward moving North American plate (east of the fault). In the Bay Area, this movement is distributed across a complex system of strike-slip, right lateral parallel and subparallel faults.

Although the site is not within an Alquist-Priolo Special Studies Zone (SSZ)[3] or mapped in a "Near-Source Zone" (ICBO 1998), based on history and theory it will be subjected to strong shaking from earthquakes generated along the San Andreas (located about 9 miles to the southwest), the Seal Cove-San Gregorio (about 20 miles to the west) and Hayward (about 10 miles to the northeast) faults, all of which are northwest trending and active. The San Andreas fault ruptured on 4/18/06 (estimated M = 8.0) and last shook the area severely on 10/17/89 (Loma Prieta, M = 7.1). A recent earthquake that epicentered near the site occurred on 3/22/57 (Daly City, M = 5.3), and another earthquake of high magnitude epicentered along the San Andreas fault on 10/1/69 (Santa Rosa, M = 5.7). The Hayward fault ruptured on 6/10/1836 and 10/21/1868 (estimated M = 7.0 and 6.8, respectively), and last severely shook the Bay Area on 12/17/54 (M = 4.5).

The site, with the building situated at approximate USGS Elevation +10, is not crossed by an active fault so the danger from direct fault offset is not present. Bedrock occurs under weak fills at significant depths, so the site's response to future earthquakes will be characterized by amplified ground shaking. Liquefaction is a potential consequence of amplified ground shaking.

Liquefaction

Liquefaction, or *cyclic mobility*, a phenomenon that occurs when loose granular soils that are saturated undergo a rapid loss in shear strength as a consequence of ground shaking, may occur at the site. Lurching, a permanent displacement of surficial deposits (adjacent to waterways that are unsupported or supported by bulkheads) that may take place as a consequence of ground shaking, may also occur at the site.

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[3] Two major acts of the California legislature regulate construction near active fault traces: The Alquist-Priolo Earthquake Fault Zoning Act (1994) and the Seismic Hazards Mapping Act (1991). The purpose of the Earthquake Fault Zoning Act is to reduce the hazards posed by surface rupture of a fault. The purpose of the Seismic Hazards Mapping Act is to protect the public safety from the effects of strong groundshaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. Development permits for a site (for a new building) within a seismic hazard zone must be withheld until a geotechnical evaluation of the site has been conducted and appropriate mitigation measures incorporated into the project plans. The Jelly's site is within a Liquefaction Hazard Zone (CDM&G, 1996) however as the building is existing, the intent is to upgrade, not construct a new building.

In San Francisco, the potential for liquefaction[4] poses a substantial hazard in areas of old artificial fill for three reasons: (1) hydraulic fills are typically well sorted and (if submerged) they are susceptible to liquefaction, (2) old graded fills below the water table, even using homogeneous materials, typically lack compaction (the voids are filled with water) and as such are susceptible to liquefaction, and (3) old graded fills usually lacked control of content, so reducible materials (eventually to be replaced with water) as well as mineral soils and rock were used, and they are susceptible to liquefaction.

Much of the old artificial fill was placed along the waterfront before modern engineering methods of compaction were developed or known to be needed. Essentially, any available material was dumped into the Bay at the shoreline until the new land surface was above high-tide level. The result was a loose, saturated deposit composed of irregular pockets of sand, gravel, rock, brick, lumber, or other disposed material. Only light structures could be supported on such substrate because almost any weight caused the fill to settle. During seismic groundshaking, vibration can cause this type of fill to settle or liquefy under certain conditions. Such conditions do not exist throughout all filled areas, but because there is no record of what was used for fill at most sites along the former shoreline, only site-specific geotechnical investigations can demonstrate the presence or absence of liquefiable material. The fill at the Jelly's site is relatively loose material and may be subject to liquefaction.

Design Regulations

The direct effects of seismically-induced groundshaking result from a combination of the cyclic horizontal and vertical movements of the ground during an earthquake, the coherence of the geologic material being shaken, and the quality of construction supported on or by that material.

Seismic ground motions range from very low intensities which cannot be detected, except by specialized equipment, to high intensities that can cause buildings to be shaken apart and heavy objects to be thrown into the air. A single earthquake can create the entire range of effects, depending on the moment magnitude of the earthquake, a given site's distance from the source of the earthquake, the geologic conditions at the site, and the design of the buildings on the site. Bedrock formations (such as the Franciscan sandstone deep beneath the site) tend to be less affected by groundshaking than are unconsolidated sediments (such as the sand, mud, and artificial fill overlying the bedrock at the site).

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[4] A response to severe groundshaking that can occur in submerged loose soils. This transformation from a solid state to a liquid state ("quicksand"), as a response to seismically-induced groundshaking, can cause ground settling and greatly increased pressure on bulkheads. Earthquake-induced liquefaction does not affect bedrock; however, it does affect certain types of alluvium and artificial fill under conditions of saturation. The characteristics of a liquefaction-prone deposit include: (1) uniformly fine sand or sandy soil; (2) saturated conditions—usually by groundwater or at below sea level locations; (3) loose to moderately dense compaction; and (4) little or no clay-sized particles to act as binders. If these conditions occur within about 30 to 40 ft. below the ground surface, vibration sufficiently violent to increase pore pressure beyond the shear strength of the sand particles could cause such soils to liquefy. Any structures supported on the soils would be subject to tilting or settlement (sometimes very violent and rapid) as the supporting capabilities of the liquefying soil diminished.

As a general rule, the intensity of groundshaking increases with proximity to the source of the earthquake. However, given similar location and seismic energy output, the least amount of damaging vibration would occur on a site that was completely composed of bedrock. A site underlain by major thicknesses of sediments (such as the fill, estuarine, alluvial and marine sequence beneath the Jelly's site) would be subject to more severe vibration because of the sediments' tendency to deform to a greater degree than the bedrock. For structures supported on sediments, the combination of ground deformation and susceptible building design (including foundation design) appears to determine the extent of damage, with well-constructed buildings founded on dense undisturbed native deposits performing considerably better than moderately or poorly constructed buildings on unengineered fill.

Although the 1995 San Francisco Building Code and the 1997 Uniform Building Code prescribe design parameters for structures, including consideration of "Near-Source Effects" (ICBO, 1998), as the site is situated in a Liquefaction Hazard Zone (CDM&G 1996), and although it is not a new building and not within a "near source zone", it is prudent to introduce discussion of fault activity in modern descriptive terms that are not generally in the codes and acts, "moment magnitude"[5] and "characteristic earthquake"[6] (a term that replaces MCE, a "maximum credible earthquake"[7]) .

With the increased flow of information from studies of recent large earthquakes (e.g. Loma Prieta 1989, Northridge 1994, Kobe 1995), it has become necessary to define more precisely the seismic conditions in which planning and development occur, particularly in California. This has been accomplished largely through major revisions to the 1994 Uniform Building Code which the 1995 San Francisco Building Code is based on, and then the 1997 Uniform Building Code. The current methods rely on these more specific terms to increase their accessibility to those who design, construct, and inspect buildings to meet the standards of the codes. Their increasing use in planning documents facilitates document review by city and state agencies responsible for oversight of geotechnical and structural design issues.

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[5] Moment Magnitude (M_w): A logarithmic scale used by modern seismologists to measure the amount of energy released by an earthquake. For the purposes of describing this energy release (the "size" of the earthquake on a particular fault segment for which seismic-resistant construction must be designed) the moment magnitude (M_w) of the characteristic earthquake for that segment has replaced the concept of a maximum credible earthquake of a particular Richter magnitude. This has become necessary because the Richter scale "saturates" at the higher magnitudes; that is, the Richter scale has difficulty differentiating the size of earthquakes above M=7.5. The M_w scale is proportional to the area of the fault surface that shifts (slips) during an earthquake, and, thus is directly related to the length of the rupture. It reflects the amount of "work" (in the sense of classical physics) done by the earthquake. Although the numbers of the M_w scale may appear lower than those of the traditional Richter magnitudes, they convey more precise (and more useable) information to geotechnical and structural engineers.

[6] Characteristic Earthquake: The moment magnitude (M_w) of the seismic event considered representative of a particular fault segment, based on seismologic observations and statistical analysis of the probability that a larger earthquake would not be generated during a given time frame. In the Bay Area, the characteristic earthquake for the Peninsula segment of the San Andreas fault has a moment magnitude (Mw = 7.1; the entire Hayward fault, a M_w = 7.3; and the northern segment of the Calaveras fault, M_w = 6.9. The term "characteristic earthquake" replaces the term "maximum credible earthquake" as a more reliable descriptor of future fault activity.

[7] The largest Richter magnitude (M) seismic event that appears to be reasonably capable of occurring under the conditions of the presently known geological framework. This term, maximum credible earthquake, has been replaced by the term "characteristic earthquake", which is considered a better indicator of probable seismic activity on a given fault segment within a specific time frame.

The San Andreas, Seal Cove-San Gregorio, Hayward, and Calaveras fault zones are historically active faults (during the last 200 years) in the San Andreas fault system. The San Francisco Peninsula segment of the San Andreas fault and the Seal Cove-San Gregorio fault are capable of generating a characteristic earthquake of moment magnitude $M_w = 7.1$; the Hayward fault, $M_w = 7.3$; and the Calaveras fault, $M_w = 6.9$. Earthquakes of these magnitudes are sufficient to create horizontal ground accelerations[8] greater than 0.50g (50 percent of the acceleration of gravity) in bedrock or in unconsolidated sediments, which are severe enough to cause major damage to structures, foundations, and underground utility lines. The 4/18/06 earthquake, which ruptured all three segments of the San Andreas fault in the Bay Area, has been estimated at about $M_w = 8.0$ (about M = 8.3 on the Richter[9] scale). The Loma Prieta earthquake of 10/17/89 on the Santa Cruz segment of the San Andreas fault was measured at $M_w = 6.9$ (Richter magnitude M = 7.1).

After the 1989 Loma Prieta earthquake, the U.S. Geological Survey estimated the probability of at least one large earthquake (Richter Magnitude M = 7 or greater) in the San Francisco Bay region within the 30-year period between 1990 and 2020 at about 67 percent. Recent studies by the U.S. Geological Survey indicate, unofficially, that the probability may be as high as 90 percent. On the San Francisco Peninsula segment of the San Andreas fault, the probability that a large earthquake would occur in this time-frame is estimated at about 23 percent.

Site Response

The Association of Bay Area Governments has created computer models of the damage expected from major earthquakes on various segments of San Francisco Bay Area faults. The models produce maps showing the effects of seismic groundshaking as zones which correspond to Modified Mercalli Intensities.[10]

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[8] *Horizontal ground acceleration* is the speed at which soil or rock materials are displaced by seismic waves, measured as a percentage of the acceleration of gravity (0.5g = 50% of 32 feet per second squared, expressed as a horizontal force). *Peak horizontal ground acceleration* is the maximum acceleration expected from the characteristic earthquake predicted to affect a given area. Repeatable acceleration refers to the acceleration resulting from multiple seismic shocks. *Sustained horizontal ground acceleration* refers to the acceleration produced by continuous seismic shaking from a single, long duration event.

[9] Richter Magnitude (M) is a logarithmic scale developed in 1935 to 1936 by Charles F. Richter and Beno Gutenberg to measure earthquake magnitude by the amount of energy released, as opposed to earthquake intensity as determined by local effects on people, structures, and earth materials (for which, see Modified Marcel Intensity Scale). Each whole number on the Richter scale represents a 10-fold increase in amplitude of the waves recorded on a seismogram and about a 31-fold increase in the amount of energy released by the earthquake. Because the Richter scale tends to saturate above about M = 7.5, it is being replaced in modern seismologic investigations by the moment magnitude (M_w) scale.

[10] Modified Mercalli Intensity (MMI) Scale is a 12 point scale of earthquake intensity based on local effects experienced by people, structures, and earth materials. Each succeeding step on the scale describes a progressively greater amount of damage at a given point of observation. Effects range from those which are detectable only by seismicity recording instruments (I) to total destruction (XII). Most people will feel Intensity IV ground motion indoors and Intensity V outside. Intensity VII frightens most people, and Intensity VIII causes alarm approaching panic. The scale was developed in 1902 by Giuseppi Mercalli for European conditions, adapted in 1931 by American seismologists Harry Wood and Frank Neumann for conditions in North America, and modified in 1958 by Charles Richter to accommodate modern structural design features.

The models for San Francisco indicate that a M_w = 7.1 earthquake on the Peninsula segment of the San Andreas fault would cause moderate structural damage (MM Intensity VIII) at the Jelly's site: heavy structural damage (MM Intensity IX) would be caused by a M_w = 7.3 earthquake that ruptured the entire length of the Hayward fault. The effects of MM Intensity VIII groundshaking are general damage to ordinarily substantial buildings, including partial collapse; some damage to specially designed structures; twisting or fall of chimneys, factory stacks, towers, and unreinforced masonry walls; movement of frame houses on their foundations, if they are not bolted in place; breaking of tree limbs and decayed timber pilings; and cracking of wet ground. The effects of MM Intensity IX groundshaking are considerable damage to specially designed structures; great damage to ordinarily substantial buildings, including partial collapse; destruction of poorly built structures; and liquefaction, settlement and ground cracking of fill and other saturated fine sandy deposits.

Expected seismic ground motion at the site, based on criteria in the 1995 SFBC, indicate high horizontal and vertical forces would occur because of the site being less than 10 miles from the San Andreas and Hayward faults and the ground motion amplifying effects of soft underlying sediments (especially Bay Mud). Because these two effects could increase the horizontal and vertical forces at the site beyond the range established by 1995 SFBC, site-specific determination using the 1997 UBC/1998 CBC is discussed below to set design parameters for the lateral force resisting system. As it turns out, there is no practical difference between the results using the 1995 SFBC or the 1997 UBC/1998 CBC.

Lateral Spreading

The presence of Bay Mud is closely associated in waterfront areas having old artificial fill and is another factor in the potential liquefaction hazard. The old waterfront contained some relatively deep basins that were filled as the man-made land area expanded seaward. The upper portions of the Bay Mud deposits that form the floors of those basins are as much as 50 percent water and contain layers of uniformly fine sand. The actual "mud" reacts to seismic shaking by spreading, undulating and settling, but the sand layers, possessing all the conditions of a liquefiable deposit, can and do liquefy, compromising the integrity of any foundations supported on them or on the overlying fill. Again, the layers of fine sand do not exist throughout all Bay Mud deposits, but only site specific geotechnical investigations can demonstrate their presence or absence. If required, their presence and other characteristics of the underlying materials may be readily determined by advancing an exploratory boring.

Tides

The groundwater at the site is subject to tidal influence, so the possibility of losing ground (particulate matter) during ebb tides exists. Lost ground will result in subsidence of bearing type building foundations and settling of pavements. Locally, groundwater level changes of up to three feet were measured within a tidal cycle (between the elevations of the highest tide and the lowest tide) and the tidal influence has also been indicated by the presence of elevated concentrations of total dissolved solids measured in groundwater samples.

Design

Superstructure

The partial upgrade of the building superstructure should be designed in accordance with the 1995 San Francisco Building Code (1995 SFBC) as a minimum, providing that the 1995 SFBC is still in effect at the time of permit application. Alternatively, if permitted by the Department of Building Inspection-Plans Approval Division (DBI-PAD), the design could follow the 1997 UBC.

As this report includes information about nearby earthquake faults, a brief discussion concerning seismic design follows, based on changes in seismic design requirements in the 1997 UBC, which reflect very current state-of-the-art engineering regarding seismic safety, per regulations. It has long been recognized that forces induced in buildings due to seismic accelerations typically attenuate (reduce) dramatically with distance from the source of the earthquake. However, this has not been recognized in the required forces stipulated in the UBC, which varied only by large geographically defined "zones"; the Bay Area has been long recognized to be in the zone of maximum code specified force levels, Zone 4. In the 1997 UBC, two different types of "near-source" multiplication factors have been added to forces otherwise prescribed for structures in Zone 4. For proximity to major faults such as the San Andreas, the factor varies from 2.0 for structures within 2 kilometers of the fault to 1.0 at 15 kilometer distances and greater. As shown below, the location of Jelly's is not close enough to the San Andreas or Hayward faults to be seriously affected by near-fault effects, however the building's location in the Liquefaction Hazard Area warrants special design consideration.

Near-Source factors appear in 1997 UBC §1630 with a limited modifier in §1629.4.2. Tables involved are 16-L and 16-M for defining irregularities, 16-Q through 16-T for near-source factors and force coefficients, and 16-U for seismic source type. There are actually two different near-source factors defined, N_a and N_v, to be applied to determine force coefficients C_a and C_v. For buildings designed by "static force procedures" as would be appropriate for this building, base shear forces are prescribed by four equations in 1997 UBC §1630.2.1. The first equation, 30-4, is general to establish base shear forces, and includes C_v. Equation 30-5 sets a permissible upper limit including C_a, while equations 30-6 and 30-7 set two different lower limits based on C_a and N_v. All factors are affected by the seismic source type, A through C, from severe to less so; Type C carries factors of 1.0 only, while Types A and B factors vary from 2.0 to 1.0 based on Type and distance from the source. All factors are also affected by the nature of the soil as defined in 1997 UBC, Table 16-J, by Types S_A through S_E, from hard rock to soft soil, with S_F a type requiring site-specific evaluation. Type S_E is applicable to the Jelly's site.

Distances are defined in 1997 UBC Tables 16-S and 16-T as referenced to "approved geotechnical data, with mapping by the United States Geological Service and the California Division of Mines and Geology" referenced as standards. The two sets of maps should yield similar results, but thus far the California maps seem easier to apply, and for reference they are used herein. The site is covered by Map E-17 of the California Division of Mines and Geology (ICBO 1998) maps, which shows (with Map D-17) a four kilometer wide swath, 2 km each side of the San Andreas Fault, trending Southeast to Northwest, and a similar swath of the Hayward Fault.

The subject site is 14 km from the San Andreas fault and 16 km from the Hayward fault. Jelly's is effectively at the "$\geq$10 km" distance for the purposes of 1997 UBC Tables 16-S but between the 10 km and the $\geq$15 km distance for the purpose of 1997 UBC Table 16-T. Type C faults are not significant for mapping the near-source problem as defined in the 1997 UBC, so they are not mapped.

Therefore, from 1997 UBC Table 16-S, with Type A source at $\geq$10 km, $N_a = 1.0$. From Table 16-Q, for Soil Type S_E in Zone 4, $C_a = 0.36N_a = 0.36(1.0) = 0.36$. In Table 16-T, for linear interpolation of a Type A source at 14 km (within the known seismic source of 10 to 15 km, the range of the tabulated values), $N_v = 1.04$. Applying the same Soil Type and Zone in Table 16-R, $C_v = 0.96N_v = 0.96(1.04) = 0.998 \approx 1.0$. As applied in equation 30-4, the basic base shear is amplified by a factor of 1.00, a measure that does not change from the 1994 UBC, based on the "near-source" effects. This factor is recommended for design of building superstructure improvements concurrently with any foundation work, which according to the regulations, will control any extraordinary design of the proposed improvements.

1997 UBC equation 30-5, the upper limit, uses $C_a = 0.66$, as does the lower limit in equation 30-6. The alternative lower limit of equation 30-7 includes the near-source factor N_v, without modification by Soil Type, effectively raising that lower limit. The larger value as between the two lower limits would control if close to the near source, but at the subject site $C_a = 0.36$.

The net effect is that newest design requirements (which are safety requirements), those in the 1997 UBC and incorporated into the 1998 California Building Code (1998 CBC), which are likely to be adopted into the SFBC for a near-source site, are affected substantially by the site's location. For the Jelly's site, there is no increase in seismic effect over the 1995 SFBC for design, however the critical issue is the integrity of the substructure.

Substructure

As previously noted, the building is founded on three different types of support: The one story part closest to the Bay is founded on a reinforced concrete, pile supported wharf; both the one and two story parts are founded on the seawall, and both one and two story parts farthest from the Bay are founded in landfill. The building has suffered differential subsidence at the column situated at the juncture of the one and two story parts founded in the landfill; no significant subsidence appears at the part of the building on the seawall.

The differential subsidence is due to concentrated loads of different magnitudes on the foundation; the subsided column has relatively high loads. The cause of the movement is due to one of three factors: (A) if the column has a spread footing, it has settled with compression of the ground and/or lost ground under the foundation, (B) if the column is supported by long wood piles the pile tops may have rotted, or (C) if the column is supported by short wood piles the piles may have subsided. Available plans (C&CSF 1953) show the building was a remodeled existing building and no foundation details are shown.

Recommendations

For a partial (or full) seismic upgrade, the only unknown design constraint is the type and condition of the foundation support that exists in the landfill, particularly at the column at the one to two story transition near the center of the building. The foundation type and condition may be investigated by excavating around the column, preferably using a small backhoe or bobcat, or even by hand.

After investigation, the foundation support may be repaired and improved by one of several methods, depending on the existing construction and its condition, as follows: (A) if the column has a spread footing, it may be underpinned using one or more driven steel pipe piles and a poured-in-place reinforced concrete pile cap; (B) if the column is supported by long wood piles and the pile tops have rotted, the tops may be cut off and a new deep reinforced concrete pile cap may be installed after raising the column or (C) if the column is supported by short wood piles and they have subsided, the column may be raised and underpinned on the existing wood piles or on support supplemented with a steel pipe pile.

The determination of methods to improve foundation support may be accomplished prior to designing the superstructure modifications, or may be suggested (consistent with the planned removal of one interior column) in the design documents using one or all three alternatives, with the final configuration to be determined during construction and shown on a revised drawing submitted to the DBI-PAD when the conditions are known and the method determined.

Toxics

The San Francisco Public Works Code (Article 20, Section 1000 et. seq.) entitled "Analyzing the Soil for Hazardous Waste," commonly known as the *Maher Ordinance*, requires building permit applicants proposing to disturb 50 cubic yards of soil or more eastward of the 1851 high tide line to conduct environmental assessments of that soil for possible hazardous waste, known also as toxic substances.[11] Where hazardous wastes are found in excess of state or federal standards, the permit applicant is required to submit a site mitigation plan prepared by a qualified expert to the Director of Public Health and the Director of Public Works, and must implement the site mitigation plan and certify completion prior to issuance of any building permit. Where hazardous wastes are found for which no standards are established, the permit applicant must request a determination from the Director of Public Health as to whether a site mitigation plan is needed. The Jelly's site is within the geographic area covered by this ordinance however the building may be remodeled without disturbing 50 cubic yards of soil.

[11] Toxic substances may cause short-term or long-lasting health effects, ranging from temporary effects to permanent disability, or death; such substances can cause disorientation, acute allergic reactions, asphyxiation, skin irritation, or other adverse health effects if human exposure exceeds cervix levels (the level depends on the substance involved). Carcinogens (substances known to cause cancer) are a special class of toxic substances. Examples of toxic substances include benzene, which is a component of gasoline and a suspected carcinogen, and methylene chloride, a common laboratory solvent.

Safety

The Contractor shall furnish all materials and equipment required for the work, and shall be responsible for the design of all temporary shoring. Grades, temporary slopes, control of groundwater, protection of existing improvements off the property, drainage during construction, and all safety precautions, are the sole responsibilities of the Contractor. Cal/OSHA safety rules must be observed throughout the course of construction. The Contractor shall be solely responsible for all safety at the jobsite during the entire construction period.

Verification

All construction must conform to and be in accordance with the 1995 Building Code of the City and County of San Francisco and all applicable State of California laws, ordinances, and regulations. It is further recommended that geotechnical engineering services be provided during any excavation, underpinning and other foundation construction. Engineering observations are to verify compliance with the design concepts, specifications and recommendations and to allow changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. An engineer qualified in foundation engineering (the "Engineer-of-Record") should observe all aspects of any foundation construction.

In order to effectively accomplish these observations, it is recommended that a pre-construction meeting be held between all design professionals and Contractors to develop procedures for communication throughout the project. It is requested that the Owner's representative or the Contractor contact the Engineer-of-Record at least 48 hours prior to the commencement of any of the construction phases listed above. The City and County of San Francisco will probably require that the Engineer-of-Record provide certification that soil and structure related special inspections have been performed in accordance with 1995 SFBC §1701.

Limitations

The evaluation and recommendations submitted in this report are based on reconnaissance and research, data from published and private geotechnic literature, evaluation of the performance of the foundation systems for nearby structures, evaluation of geotechnical data gathered for the surrounding area, and local experience. Some variation in the nature and extent of the expected soil conditions across the site may become evident during construction, and it may be necessary to modify the recommendations given in this report accordingly.

The services provided herein consist of professional opinions, conclusions, and recommendations made in accordance with the scope of work assigned and generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either indicated or implied.

Yours truly,

Lawrence B. Karp

LICENSED ARCHITECT LAWRENCE B. KARP No. 10130 REN. 5/31/05 STATE OF CALIFORNIA

LICENSED PROFESSIONAL ENGINEER LAWRENCE B. KARP No. 25389 Ren. 12/31/05 CIVIL STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER LAWRENCE B. KARP No. 452 Exp. 12/31/01 GEOTECHNICAL STATE OF CALIFORNIA

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