DEFERRED MAINTENANCE AND CODE COMPLIANCE STUDY

COMPREHENSIVE FACILITY CONDITION AND USE EFFICIENCY ASSESSMENT | December 2018

VOLUME II

CITY OF CUPERTINO

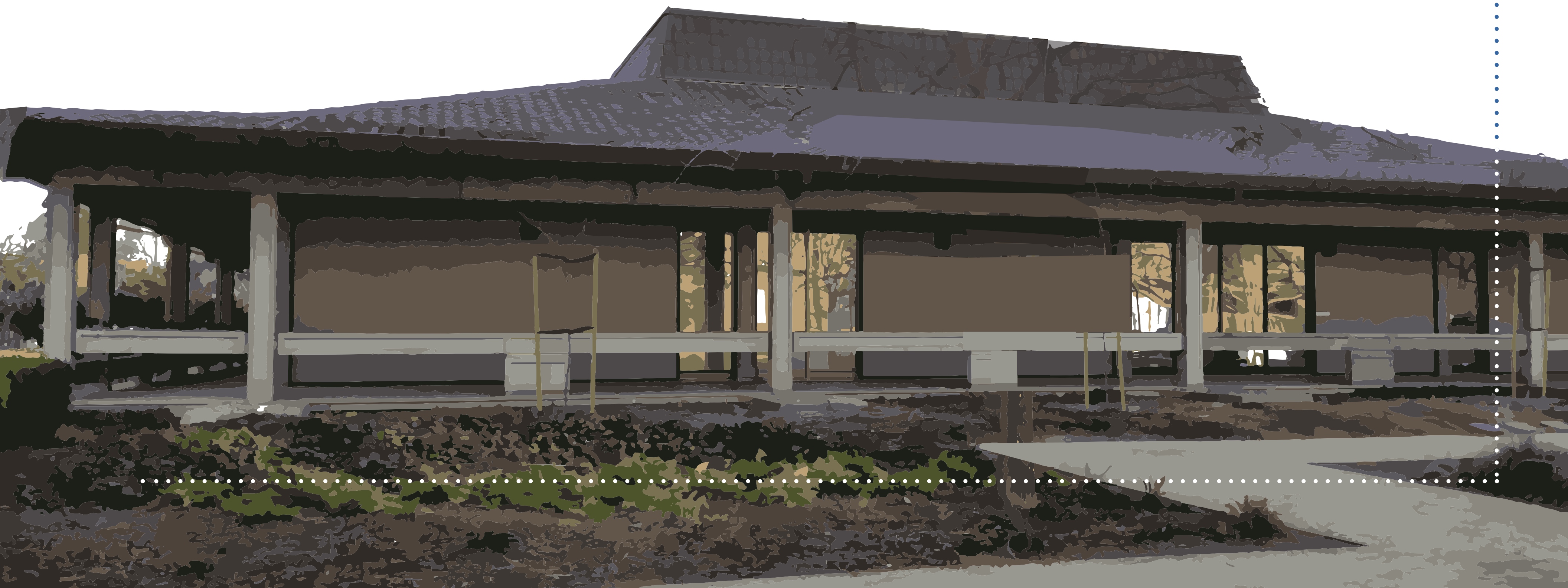
VOLUME II

CUPERTINO CITY HALL

COMPREHENSIVE FACILITY CONDITION AND USE EFFICIENCY ASSESSMENT | December 2018

10300 Torre Ave, Cupertino, CA

CITY OF CUPERTINO



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CITY HALL

ADDITIONAL INFORMATION

CITY HALL: TOP 10 CIP PROJECTS & 5-YEAR CIP PROJECT LIST

Project #	Priority	Facility	Area of Building	Description	Fiscal Year Programmed
1	1	City Hall	Entire	Seismic retrofit	2019
2	1	City Hall	Elevator	Install new ADA compliant elevator.	2020
3	1	City Hall	Entire	Remove old diesel generator and install new generator on exterior concrete pad for emergency power.	2020
4	2	City Hall	Interior	Interior renovations including light sensor and interior remodel as Cupertino sees fit	2020
5	2	City Hall	Entire	Electrical System Replacement	2020
6	1	City Hall	Entire	ADA improvements	2021
7	2	City Hall	Entire	HVAC System Replacement with EMS and equipment curbing replacement	2021
8	2	City Hall	Storefront / exterior	Storefront & exterior improvements	2021
9	2	City Hall	Site	Sidewalk repairs at upper level sidewalk that is showing sign s of settlement	2021
10	2	City Hall	Roof	Roof renovations including increased drainage and new roofing material	2021

2020 Project List		
Priority	Description	Budget Estimate
1	Seismic Retrofit	$1,653,750
1	New Elevator	$744,188
1	Diesel Generator (Remove old diesel generator and install new generator on exterior concrete pad for emergency power)	$413,438
2	Interior Renovations (remodel including light sensors and interior remodel as Cupertino sees fit)	$413,438
2	Electrical System Replacement	$82,688

NOTE:

Projects highlighted in green have a separate design budget that is planned for the fiscal year previous to the one indicated.

The estimated dollar amounts shown in the 5-Yr CIP Project List include contingency and escalation costs. Overall CIP totals shown below include a 50% contingency for design fees and other unforeseen costs as well as an escalation factor of 5% per year. Totals for the various categories assessed of City Hall are:

Site/Civil/Landscape	$520,931
Exterior Envelope	$2,071,322
Roofing	$1,034,421
Structure	$1,641,938
Interior Elements	$5,582,588
MEP Systems	$2,592,253
ADA Compliance	$1,379,228
Urgent Repairs/Renovations	$4,178,790
Reliability/Resiliency	$4,950,855
Comfort/Efficiency	$5,693,034
TOTAL	$14,822,679

CITY HALL: TOP 10 CIP PROJECTS & 5-YEAR CIP PROJECT LIST

2021 Project List		
Priority	Description	Budget Estimate
1	ADA Improvements	$1,389,150
2	HVAC System (New HVAC system with EMS & equipment curbing replacement)	$434,109
2	Storefront & Exterior Improvements	$1,736,438
2	Sidewalk Repairs (Repairs to upper level sidewalk which is showing signs of settlement)	$173,644
2	Roof Renovations	$1,041,863
2	Site Improvements	$347,288
3	Advanced Exterior Façade	$173,644
3	MEP Efficiency (Retrofits or new aspects to MEP systems to improve building energy efficiency. Further efficiency study is required.)	$173,644
3	Advanced Interior Renovations	$5,209,313

CONDITION SUMMARY - CITY HALL

Overall Rating 2.80

Facility Condition

Site 3.59

The existing site of Cupertino's City Hall is shared with the Cupertino Library and Community Hall. The site is open to the public with perimeter fencing along the creek on the east side of the property and is in good condition overall. Some chipping of concrete is present throughout the perimeter sidewalk and curbing in the parking lot. The parking lot asphalt is in good condition and was overlayed and re-striped in 2007. Ground slope levels on the edges of some parking lot spaces near curbs exceed 7%. The parking lot is comprised of accessible spaces and standard spaces, with a few parking spaces specified for City Employee vehicle parking. ADA accessibility to travel from the parking lot to City Hall is satisfactory, with a ramp on the east side of the building and an expansive sloped walkway leading into the main lobby of City Hall on the first level. The site is heavily landscaped with healthy trees and ample vegetation throughout. Irrigation systems are fully automated and in good condition. A transformer is located on the southwest side and feeds the building's electrical panels.

Exterior Envelope 2.71

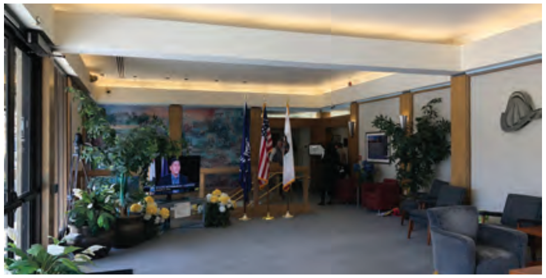
The exterior finish of City Hall is composed of 8" boards whose paint is peeling in places. Roof eaves are showing signs of deterioration and there is evidence of wasps living in soffits under the eaves. The clay tile roof is deteriorated with some tiles missing or cracked. Aluminum storefront surrounds the building and its sealant condition is dried out in several locations. Roof parapet sealant is deteriorating around metal caps. There is pooling water under rooftop equipment that is allowing algae to grow and this pooling water is susceptible to potential seepage. Roof drains are clear, but drains themselves are deteriorating due to rust.

Structure 2.15

Previous engineering studies indicate that City Hall's structure is deficient in seismic force resistance. City Hall's structure is composed of concrete columns and walls with concrete pan joist construction as well as glulam wood beams. The basement is constructed over a concrete slab-on-grade. In the 1986 renovation, a concrete slab was extended over the basement patio level which allowed for the architectural arcade element to be reproduced on this north side of the building. Furthermore, steel structural support was added for the opening for the large staircase descending from the middle of the City Hall lobby to the basement level. There is a concrete railing that surrounds the building perimeter exterior sidewalk on the first level. This railing is cracked in places but is in fair condition overall. Perhaps more serious is settlement shown at the northwest building corner perimeter sidewalk. Exposed wood glulam beams are in generally good condition. Previous structural reports have found deficiencies with concrete shear wall reinforcement and associated anchor bolt connections. Concrete footings may prove inadequate should shear wall reinforcement take place. Equipment anchorage on rooftop equipment is a non-structural seismic hazard due to deterioration. City Hall is still operating as Cupertino's EOC even though structural requirements are not met.

Interior 2.20

City Hall features various offices for city officials, city service representatives and employees for Cupertino's operation. The main entrance to City Hall is on the upper story of the building, which acts as the main level. This level houses the Mayor's office, City Manager's office, City Clerk's office, IT department and offices of other city officials. Public access to these spaces involves notary use or private meetings with city



staff. The basement floor of City Hall houses Public Works, Planning and Community Development. Interior finishes at the basement level are significantly more deficient than finishes in the upper level. Carpet in the basement level was installed during the 1986 remodel.

Lighting throughout City Hall dates back to the 1986 renovation and most units contain fluorescent linear T8 tubes. Lighting is not adequately laterally supported in the basement level or other areas. There are motion controls for lighting in the kitchen, bathrooms, stairwell and conference room "A". Other areas are on time schedules via relay controls, including the corridors. Dimming functionality is installed for meeting rooms.

City Hall features a large video broadcasting room for local Cupertino television as well as other rooms with data equipment.

MEP Systems 2.52

In general, City Hall's MEP systems are outdated and insufficient for building operations, modern building codes and energy efficiency standards. Most equipment is located on the basement level in a large mechanical room with smaller equipment mounted on the roof. Fire hazards exist because of haphazardly stacked and crammed systems located in this basement room. The original boiler from the 1965 design of City Hall is still in operation and the HVAC system is fed by this boiler. The HVAC system was most recently renovated in 1986 and its equipment is beyond its useful service life. The HVAC control system is a pneumatic system which requires a significant amount of maintenance.

Air circulation throughout both the basement and first levels of the building is insufficient and fresh air levels are less than ideal. The mechanical room is not up to modern building codes with various components that require their own individual rooms housed together (electric switches, chiller, boiler, etc.). There is no refrigerant detection or exhaust system for the chiller. The chiller control panel is currently in the process of being replaced.

Plumbing systems are in generally good condition with the exception of sewer piping above the video department. This piping shows signs of deterioration and pitting and a more thorough investigation as to the cause is required. The hot water heater was installed around 2000 and is operating as designed. The building is fully sprinklered and previous reports are in concurrence with the fire sprinkler system appropriately serving the building. Systems should be flow tested to ensure the design volume of water is produced when needed.

Electrical service to City Hall is fed by the underground PG&E transformer with secondary power coming to City Hall by means of four (4) 4 ½ inch underground conduits to the switchboard in the basement level electrical room. The main breaker is rated at 1600 Amps and appears to be original to the building, it then feeds a distribution panel via a 1000 Amp circuit breaker. The switchboard is outdated but is adequately sized to support City Hall's existing loads. Should any additional staff be moved into City Hall, or any additional loads be required, the switchboard will have to be replaced with a new unit.

Located in the mechanical room is a diesel generator which is utilized for emergency power services. The fuel tank for the generator is located outside the building and diesel fuel is piped to the generator. Power is provided to the distribution panel via a 400 Amp automated transfer switch. This generator was installed in 1978 and is beyond its useful service life. The generator does not serve the elevator or the chiller.

Previous studies have pointed to City Hall operating at over double the ideal energy cost per square foot for a modern office building.

Fire and Life Safety 3.64

City Hall is classified as a level B occupancy with a Type V-B construction and an automatic sprinkler system throughout. The allowable building area is 34,800 square feet (SF) with built areas of approximately 11,520 SF at the ground level and 12,220 SF at the basement level. The existing elevator shaft is deficient with fire barriers that do not extend to the underside of the roof sheathing. Exit stair enclosure walls require a 1-hour fire rating. The existing door on the first level is 60-minute and the basement level door was illegible. The existing corridors open to the public area are rated per the 1986 drawings. The existing corridors open to the public area and office area are rated per the 1986 drawings and allowed per current code. Finish materials should be further examined to confirm their conformance. The occupancy load of the first level is 197 and the basement level is 124 per the Cupertino City Hall ESF Analysis. Fire sprinkler is used and checked yearly but is antiquated and in need of replacement. An audible and flashing fire alarm system is used and monitored by Sonitrol and checked yearly. A new fire riser was installed in 2017.

ADA Compliance Needs Improvement

There are accessible paths of travel from the parking lot into City Hall, including a ramp on the east side of the building exterior. Directional signage throughout the building should be replaced. The bathroom on the first level has an accessible stall that has a width smaller than the required 5' and as such needs only minor alteration to become compliant. Toilet paper shelves in the bathrooms are non-compliant for being 2" above the grab bar and should be made compliant with a minimum 12" clearance above the grab bar. The notary counter in the public reception area is non-compliant because of its 42" counter height. At least a portion of the counter should be made 28"-34" high to be ADA compliant. A more through ADA review would likely uncover additional deficiencies in and around City Hall. The ADA requirements have changed and continue to change, and an extensive ADA review would most likely reveal numerous technical violations of current accessibility standards.

EXECUTIVE SUMMARY - CITY HALL

This report contains a comprehensive assessment and analysis with recommendations for Cupertino City Hall. The building has been assessed in consideration with previous structural studies and seismic force resistance reports.

The assessment primarily involves current condition observations of site, exterior and interior elements and is combined with recommendations from previous assessments. The fundamental focus of our investigation is architectural, structural, mechanical, electrical and spatial deficiencies. Accessibility requirements were also studied throughout the building as well as life-safety reviews and building code compliance. Initial walk-throughs of City Hall have concurred with previous reports. Many mechanical, electrical and plumbing (MEP) systems are inefficient and at the end of their useful service life. The building was built in 1965 under the 1964 Uniform Building Code and remodeled in 1986 with expanded use of the basement floor.

Elements of the building that do not meet current code requirements include:

- There are not enough water closets for building capacity.
- Some parking lot spaces near curbs exceed 7% grading levels which is the maximum allowed by the California Building Code.
- The notary counter in the public reception area is non-compliant due to 42" counter height.
- Multiple ADA issues in restrooms.
- Directional signage throughout the building is lacking.
- The elevator machine room walls do not comply with fire barriers.
- Diesel generator housed in the building is a code violation.
- No refrigerant detection or exhaust.
- Existing elevator shaft may be deficient.
- Elevator does not meet ADA requirements.

Major building deficiencies include:

- The HVAC system is pneumatic with troublesome repairs and is past its useful service life.
- The boiler is original to the building and is well past its service life.
- Electrical panel is original to the building and is well past its service life.
- The chiller does not have its own exhaust.
- Air Handling Unit (AHU) is fed poor quality air due to dirty air intake.
- Emergency power should be provided from an exterior location.

Previous reports and studies have noted:

- Roof diaphragm shear capacity is exceeded.
- Existing concrete column reinforcement is inadequate.
- Building structure is deficient.

SUMMARY OF FINDINGS, RECOMMENDATIONS, IMPACT AND TIMELINE - CITY HALL

Site/Civil/Landscape

Findings

The existing site of Cupertino's City Hall is shared with the Cupertino Library and Community Hall and is surrounded by both Torre and Rodrigues Avenues. The parking lot for City Hall is accessed via Rodrigues Ave, with additional access available by traveling through the connected Library parking lot via Torre Ave.

This site is open to the public with perimeter fencing along the creek on the east side of the property and is in good condition overall. Some chipping of concrete is present throughout the perimeter sidewalk and curbing in the parking lot. The parking lot asphalt is in good condition and was overlayed and restriped in 2007. Ground slope levels on the edges of some parking lot spaces near curbs exceed 7%. The parking lot is comprised of accessible spaces and standard spaces, with a few parking spaces specified for City Employee vehicle parking.

ADA accessibility to travel from the parking lot to City Hall is satisfactory, with a ramp on the east side of the building and an expansive sloped walkway leading into the main lobby of City Hall on the first level. Exterior furniture consists of concrete and wooden benches placed throughout the site, as well as furniture for employee use at the basement patio on the north side of the building.

Overall, this site is welcoming to the public with an expansive quadrangle bringing together City Hall, Community Hall and the Cupertino Library. The site is heavily landscaped with healthy trees and ample vegetation throughout. Irrigation systems are fully automated and in good condition. The perimeter sidewalk on the upper level of the City Hall building is surrounded by shrubbery and small trees. The basement level patio is home to additional greenery. A transformer is located on the southwest side and feeds the building's electrical panels. Sewer, water and gas systems are functional with no reported problems.

Recommendations

- Grades exceeding 7% should be regraded and tree roots cleared so as to prevent more significant damage in the future.
- Sidewalk chipping should be repaired with epoxy, along with chipping on curbing throughout parking lot.
- Parking lot improvements could include an extensive ADA study to bring the site up to current code and improve building accessibility.

Impacts and Considerations

- Work on the parking lot will require closure of at least part of the parking lot, and in turn will require City Hall staff and patrons to find parking away from the building.
- Making additional ADA changes to the parking lot may lead to changes on the exterior site of City Hall, the Community Hall or the Library.
- Relocation costs are not included in project estimates.

Timeline

- Construction will require approximately two months. Users would be able to work during construction on the site, but would likely be impacted by decreased available parking. This may lead to decreased operational efficiency.

More than 7% Grade

Sidewalk/Paving Crack

Garbage Area

SUMMARY OF FINDINGS, RECOMMENDATIONS, IMPACTS AND TIMELINE - CITY HALL

Structure

Findings

Previous engineering studies indicate that City Hall's structure is deficient in seismic force resistance. City Hall's structure is composed of concrete columns and walls with concrete pan joist construction as well as glulam wood beams. The basement is constructed over a concrete slab-on-grade. In the 1986 renovation, a concrete slab was extended over the basement patio level which allowed for the architectural arcade element to be reproduced on this north side of the building. Furthermore, steel structural support was added for the opening for the large staircase descending from the middle of the City Hall lobby to the basement level. There is a concrete railing that surrounds the building perimeter exterior sidewalk on the first level. This railing is cracked in places but is in fair condition overall. Perhaps more serious is settlement shown at the northwest building corner. The perimeter sidewalk appears to be settling from the column supports of the building. Exposed wood glulam beams are in generally good condition. Previous structural reports have found deficiencies with concrete shear wall reinforcement and associated anchor bolt connections. Concrete footings may prove inadequate should shear wall reinforcement take place. Equipment anchorage on rooftop equipment is a non-structural seismic hazard due to deterioration. Previous building studies have pointed out that the building was misclassified as an Essential Services Facility (ESF) and as a result suggested that the Emergency Operations Center (EOC) should be moved to a different location. City Hall is still operating as Cupertino's EOC. Furthermore, previous engineering studies have indicated that the roofing system was not designed to support the weight of clay tiles.

Recommendations

- In the event that Cupertino wishes to bring the EOC into compliance with current code requirements, the building must be strengthened according to the higher seismic force resistance levels of an ESF classified building.
- The existing roof diaphragm can be strengthened as needed with added panel edge nailing near the building's perimeter. According to these studies, an alternate repair would be to add a second layer of plywood to further enhance the lateral force resistance. During this upgrade, new roofing materials may be installed, reducing loads. However, the tile roofing should be able to be maintained if desired. The 2014 Structural Analysis states that "even with the mass of the roof significantly reduced, the force demand on the roof diaphragm is near the capacity limit state for a plywood diaphragm given the shear forces associated with an immediate occupancy performance criteria."
- Welding around the splice plates to the steel beams at the splice connections to concrete columns should be provided in order to strengthen collector at splice capacity of the roof diaphragm.
- Additionally, these studies state that adequate anchor bolt connections at the tops of shear walls should be provided through existing beams between existing anchor bolts to sufficiently strengthen the shear-transfer connections. Shear walls should be strengthened with the installation of boundary elements to the shear walls with sufficient ties to preclude buckling. Shear wall reinforcing is not adequate and a second layer of reinforced concrete should


Cracking at Column Base


Building Exterior View


Crack in Beam

Structure

be added to the shear walls or additional concrete shear walls should be installed.
- Concrete column longitudinal reinforcement has been found to be inadequate in previous studies due to insufficient transverse confining tie reinforcements. The existing columns should be jacketed with Fibre-Wrap or reinforced concrete.
- The settlement on the Northwest corner of the building (and less serious settlement on all corners) can be repaired via slabjacking, commonly referred to as "mudjacking". This process involves pumping grout underneath settled concrete to bring concrete height up to the original level. The cracking in the concrete railing surrounding the perimeter sidewalk should be repaired via epoxy injection to prevent further deterioration.

Impacts and Considerations
- With all of the aforementioned additional structural strengthening, additional weight will be required to be supported, and as such footings will have to be made adequate via helical piers or micropiles.
- Should an extensive remodel be the wish of City Hall, additional structural changes may be required.
- Any changes to the building structure should be recalculated to ensure seismic stability.
- Occupants of the building may be required to be relocated during structural repairs.
- Relocation costs are not included in project estimates.

Timeline
- After needed calculations and drawings are produced, two months should be allocated for the construction of structural enhancements.


Additional Cracking at Column Base


Crack in Column and Settlement


Typical Exterior Structure at Main Level

SUMMARY OF FINDINGS, RECOMMENDATIONS, IMPACTS AND TIMELINE - CITY HALL

Exterior Envelope

<u>Findings</u>

The exterior finish of City Hall is composed of 8" boards whose paint is peeling in places. Roof eaves are showing signs of deterioration and there is evidence of wasps living in soffits under the eaves. The clay tile roof is deteriorated with some tiles missing or cracked. Aluminum storefront surrounds the building and its sealant condition is dried out at several locations. Roof parapet sealant is deteriorating around metal caps. There is pooling water under rooftop equipment that is allowing algae to grow and this pooling water is susceptible to potential seepage. Roof drains are clear, but drains themselves are deteriorating due to rust.

<u>Recommendations</u>

- It is recommended that the city repaint the cracked, peeling and warped boards and replace excessively cracked or warped boards.
- Windows with bad seals should be resealed.
- It is recommended to replace windows with insulated double or triple pane glazing.
- Wasps under the eave should be professionally removed to prevent further damage or deterioration to the building.
- Drainage properties of roof should be improved, especially at equipment or roof areas with pooling water.
- Damaged clay tiles should be replaced. Alternatively clay tiles should be replaced with a lighter material tile or a different roofing system material should be installed if desired. This is due to previous structural reports having recommended replacing the clay tiles due to excessive weight. However, a proper structural reinforcement should allow for keeping the clay tiles if desired.
- Roof parapet waterproofing seals should be repaired in places where cracked or no longer sealed.
- Insulate exterior walls.

<u>Impacts and Considerations</u>

- Refinishing the building exterior may lead to staff having to work inside the building during repair time.
- New glazing will allow for increased energy efficiency and temperature control for City Hall.
- Relocation costs are not included in project estimates.

<u>Timeline</u>

- Two months will be needed remove wasps, select new paint schemes and paint the building. Window upgrade could be completed during this time.
- Roof drainage improvements could take anywhere from one to three months depending on the solution involved.
- Waterproofing seal replacement should be completed as part of drainage improvements.
- Exterior insulation could take up to two months.

Typical Exterior Beam and Soffit Condition

Main City Hall Entry

Typical Concrete Columns and Handrails at Porch Area

SUMMARY OF FINDINGS, RECOMMENDATIONS, IMPACTS AND TIMELINE - CITY HALL

Interior Elements

Findings

The main entrance to City Hall is on the upper story of the building, which acts as the main level and is considered the first floor. This level houses the Mayor's office, City Manager's office, City Clerk's office and offices of other City officials, City Service representatives and day-to-day operations that allow Cupertino to run.

The basement of City Hall houses the Public Works, Building Planning and Innovatioin Technology Departments (TV). Additional basement spaces included are a lunchroom and conference room which is used as the Emergency Operations Center for the City.

Lighting throughout City Hall was replaced during the 1986 remodel and most units contain fluorescent linear T8 tubes. Lighting is not adequately laterally supported in the basement level or other areas. There are motion controls for lighting in the kitchen, bathrooms, stairwell and conference room "A". Other areas are on time schedules via relay controls, including the corridors. Dimming functionality is installed for meeting rooms.

City Hall features a large video broadcasting room for local Cupertino television as well as other rooms with data equipment. This equipment is cumbersome, not all used according to city staff, and blocks paths of travel in certain situations.

Recommendations

- Equipment that is not used in the video broadcasting and other rooms should be removed from the City Hall site.
- The video broadcasting room could potentially be moved to an offsite location, or a location in the Library if some County-leased or other space becomes available.

Impacts and Considerations

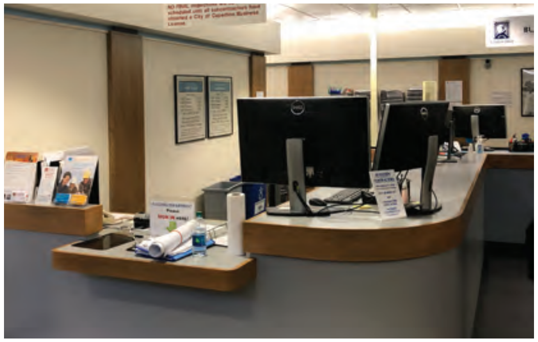
- Moving the video broadcasting room to the library or community hall could free up more space for city administrative staff.
- Removal of cumbersome equipment would allow City Hall to streamline the broadcasting process.
- Relocation costs are not included in project estimates.

Timeline

- Two months will be needed to replace ceiling tiles, refinish and replace flooring, replace toilet room finishes and fixtures, and install toilet room directional signage.

Deteriorated Ductwork

Previous Council Chambers Room



Lower Level Service Counter

MEP Systems

Findings

In general, City Hall's MEP systems are outdated and insufficient for building operations, modern building codes and energy efficiency standards. Most equipment is located on the basement level in a large mechanical room with smaller equipment mounted on the roof. Fire hazards exist within the haphazardly stacked and crammed systems located in this basement room. The HVAC system was most recently renovated in 1986 and its equipment is beyond its useful service life. The original boiler from the 1965 design of City Hall is still in operation and the HVAC system is fed by this boiler.

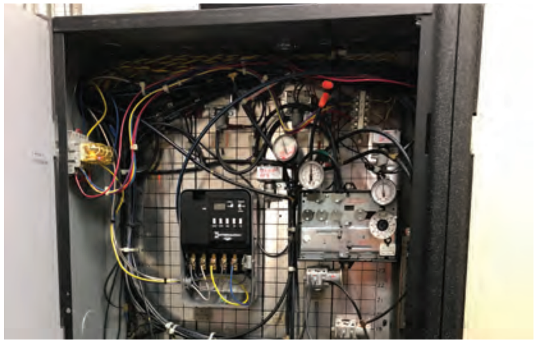
Previous studies have pointed to City Hall operating at over double the ideal energy cost per square foot for a modern office building. Air circulation throughout both the basement and first levels of the building is insufficient and fresh air levels are lower than ideal. The HVAC control system is a pneumatic system which requires a significant amount of maintenance. The mechanical room is not up to modern building codes with various components that require their own individual rooms all together in the same room (electric switches, chiller, boiler, etc.). There is no refrigerant detection or exhaust system for the chiller. This does not meet current code requirements. The chiller control panel is currently in the process of being replaced.

Plumbing systems are in generally good condition with the exception of sewer piping above the video department. This piping shows signs of deterioration and pitting and a more thorough investigation as to the cause is required. The hot water heater was installed around 2000 and is operating as designed. The building is fully sprinklered and previous reports are in concurrence with the fire sprinkler system appropriately serving the building. Systems should be flow tested to ensure the design volume of water is produced when needed.

Electrical service to City Hall is fed by the underground PG&E transformer with secondary power coming to City Hall by means of four (4) 4 ½ inch underground conduits to the switchboard in the basement level electrical room. The main breaker is rated at 1600 Amps and appears to be original to the building, it then feeds a distribution panel via a 1000 Amp circuit breaker. The switchboard is outdated but is adequately sized to support City Hall's existing loads. Should any additional staff be moved into City Hall, or any addiitonal loads be required, the switchboard will have to be replaced with a new unit.

Located in the mechanical room is a diesel generator which is utilized for emergency power services. The fuel tank for the generator is located outside the building and diesel fuel is piped to the generator. Power is provided to the distribution panel via a 400 Amp automated transfer switch. This generator was installed in 1978 and is beyond its useful service life. The generator does not serve the elevator or the chiller.

HVAC System


Pneumatic Controls


Diesel Generator Inside Building

MEP Systems

Recommendations

- In general, the 1986 HVAC system should be fully replaced or modified to allow City Hall fresh and clean air intake, proper air circulation and the energy efficiency of modern buildings. The current pneumatic control system should be replaced with modern digital controls. Here are potential options regarding fixing issues with the HVAC system:
    1. Upgrade all duct, pipe and HVAC equipment anchorages as well as seismic attachments to the building's structure. Connections to ducts and pipes should be replaced with flexible joints where required.
    2. Replace existing HVAC equipment with smaller, more efficient and more modern equipment.
    3. New HVAC systems for the entire City Hall building.
- At a minimum, the current air intake for the air handling unit (AHU) should be replaced, or air should be routed from a different location with new vents and all controllers and functions of the current AHU should be repaired.
- Plumbing systems should be studied more extensively. Deteriorating piping over the Video Department should be replaced and the cause of deterioration should be studied. At a minimum, the building's plumbing system should be inspected and deficient parts replaced. Ideally the entire plumbing system would be replaced for the longevity of the future life of the building.
- Plumbing fixtures could be replaced with more efficient units in terms of water usage. The water heater should be replaced along with the boiler, which is original to the building.
- The building's electrical and power systems, notably the original switchgear, are feeding the building's power needs currently but are beyond their useful life and should be replaced as part of the renovation to City Hall. The diesel generator should be removed from the basement. Emergency power should be provided from an exterior location.
- Exhaust installation for boiler, chiller and electrical switchboards is necessary and should be considered a priority when any changes are made to the mechanical room.

Impacts and Considerations

- Providing continued maintenance for current systems and keeping them operational may lead to increased costs for the city as opposed to the larger initial expense of replacing each of these systems with new ones.
- Removal of the diesel generator will free up a lot of space in the current mechanical room for rearrangement of new systems or equipment.
- New HVAC equipment will allow for increased temperature control, zoning and fresher air for City Hall patrons and staff.
- Occupants of the building may be required to be relocated during project activities.
- Relocation costs are not included in project estimates.

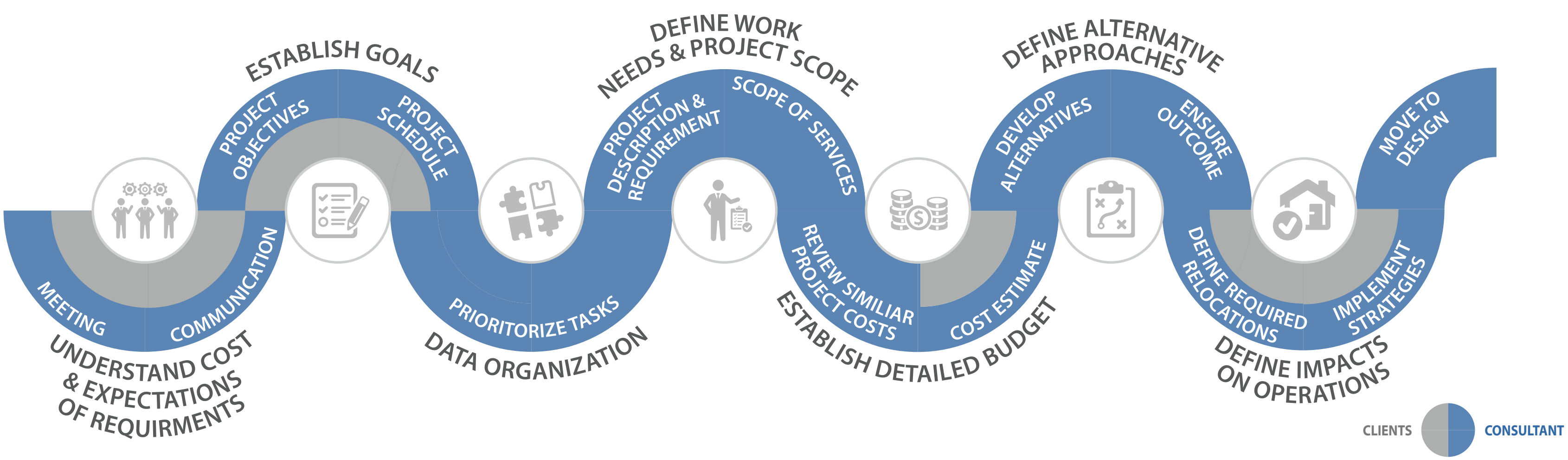
Timeline

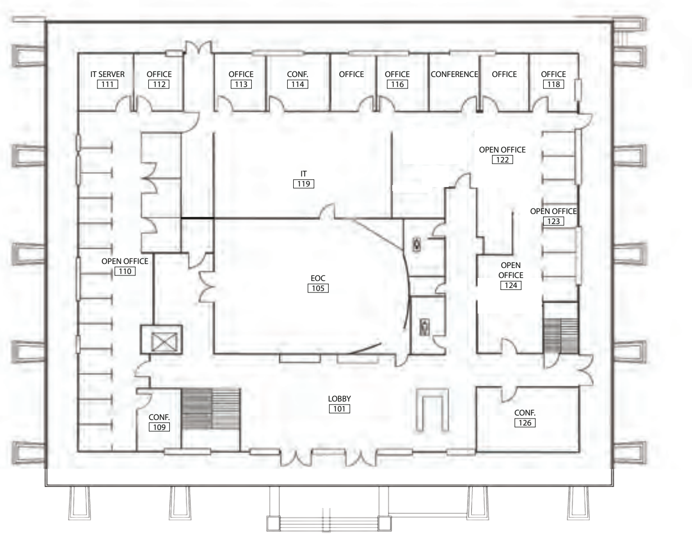
- Three months will be needed to replace the current pneumatic HVAC system with a newly designed digitally controlled system. A new system may require shutdowns of various sections of the building while new equipment is being installed, but likely not for more than a few days at a time.
- Removing the diesel generator and installing a new source of emergency power outside the building could take up to three months. Work would be minimally impacted during this time.
- Installing a new main electrical panel and streamlining the electrical systems throughout the building could take up to three months and would moderately impact work.

Mechanical Room

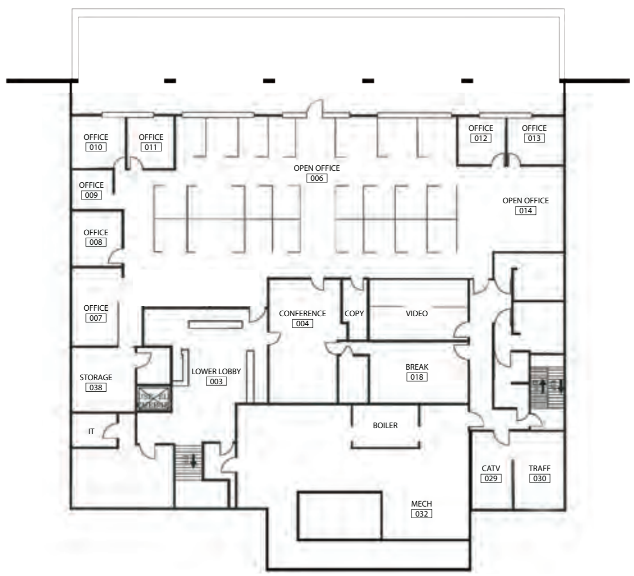
NEXT STEPS

- Establish a project budget that encompasses the city's wants and needs for City Hall renovation.
- Set an overall end goal of City Hall renovations and a timeline for that goal.
- Define a Scope of Work that itemizes what is going to be accomplished, when said tasks are going to be accomplished, and by what methodology said tasks will be accomplished.
- Establish a detailed project schedule to ensure all stakeholders are aligned with the renovation of City Hall.
- Define alternates to the Scope of Work and study these alternates to ensure a clear and properly planned outcome for City Hall.
- Define construction that requires relocation of staff and implement strategies for relocation of staff.





First Floor 11,762 SF



Basement 12,544 SF

BUILDING DESCRIPTION

The Cupertino City Hall building is a two-story facility containing city administrative, permitting and building department services and the Public Works Department. The original building was designed in 1965 by Wilfred E. Blessing. The structure is comprised of concrete slab, pan joist concrete construction and wood beams. The facility was later renovated in 1986 with a new 6" structural concrete slab on the north side which allowed for the architectural elements of the arcade to be expressed on all sides of the building. Structural enhancements were also made with a new steel frame for the installation of City Hall's main large staircase. These various improvements did not change the square footage of the building.

City Hall is accessed by an expansive ramp leading into the first level that is located on the south side of the building and central to Civic Plaza. The ground (upper) level of City Hall contains notary services, City Administration, IT department, Business Licensing and Finance Department, Human Resources and an open lobby for community interaction. A large media and meeting room uses a sizeable portion of the remainder of the ground level.

The main staircase is the primary access between the ground and basement levels of City Hall. The basement level is home to the Planning and Building Department, Public Works, more City Administration offices as well as a large mechanical systems room. There is a small patio on the north side of the basement level that is accessible from the basement floor as well as by an exterior staircase connecting the patio area to City Hall's parking lot.

GENERAL CONDITION CHECKLIST

System			Condition					
			Excellent	Good	Fair	Poor	Critical	N/A
			5	4	3	2	1	
1	Site/ Civil/ Landscape							
	1.0	General Condition		3.59				
	1.1	Perimeter Fencing						
	1.2	Equipment / Stormwater Fencing						
	1.3	On-Site Sidewalks / Crosswalks						
	1.4	Paving						
	1.5	Striping / Markings / Speed Bumps						
	1.6	Curbing						
	1.7	On-Site Signage						
	1.8	Pedestrian Access (ADA & Safety)						
	1.9	Exterior Furniture						
	1.10	Bike Racks / Storage						
	1.11	Irrigation System						
	1.12	Landscape Vegetation						
	1.13	Landscape Walls / Structures						
	1.14	Trees and Shade Systems						
	1.15	Electrical Services						
	1.16	Gas Distribution Systems						
	1.17	Storm Water Management						

NOTES:

GENERAL CONDITION CHECKLIST

System			Condition					
			Excellent	Good	Fair	Poor	Critical	N/A
			5	4	3	2	1	
2	Exterior Envelope							
	2.0	General Condition			2.59			
	2.1	General Appearance						
	2.2	Exterior Finish				See Note 2.2		
	2.3	Covered Walkways / Canopy				See Note 2.3		
	2.4	Doors/ Windows/ Louvers						
		A. Windows					See Note 2.4 A	
		B. Louvers and Vents						
		C. Main Entry Doors & Hardware						
		D. Other Exterior Doors & Hardware						
	2.5	Exterior Walls						
	2.6	Waterproofing						
	2.7	Soffits				See Note 2.7		
	2.8	Roofing						
		A. Condition Rating						
		B. Roof Openings (Access)				See Note 2.8 B		
		C. Roof Equipment Curbing				See Note 2.8 C		
		D. Leakage						
		E. Ponding Water				See Note 2.8 E		
		F. Roof Drainage						
		G. Gutters / Downspouts						

NOTES:

2.2 - 8" painted boards. Roof fascia boards are cracked, warped, peeling & need repair.

2.3 - Connection to Civic Center with overhead canopy is in good condition. Covered walkways around building are dusty. Concrete railing surrounding the building underneath the upper level covered walkway is in poor condition with many cracks.

2.4 A - Fixed full-size aluminum windows. Single-pane windows. One window on the east wall has a bad seal.

2.7 - Soffits are dusty. Mud observed on west/east walls at soffit.

2.8 B - Straight ladder to roof has elements that should be resecured.

2.8 C - Rooftop equipment curbing is in poor condition and shows signs of rust, mildew and deterioration. This could be a non-structural seismic hazard.

2.8 E - Some water is pooling under rooftop equipment. Some water is pooling near water tower.

GENERAL CONDITION CHECKLIST

System			Condition: Excellent 5	Good 4	Fair 3	Poor 2	Critical 1	N/A
3		**Structure**						
3.0		General Condition				**2.15**		
3.1		Foundation/ Footing				See Note 3.1		
	A.	Settlement				See Note 3.1 A		
3.2		Columns						
	A.	Concrete Column Reinforcement for				See Note 3.2 A		
3.3		Framing System						
	A.	Wood Framing Condition						
	B.	Roof Diaphragm Shear Capacity					See Note 3.3 B	
	C.	Roof Diaphragm Collector Splice Capacity				See Note 3.3 C		
3.4		Walls						
	A.	Anchor Bolt Connections at top of Shear				See Note 3.4 A		
	B.	Concrete Shear Wall Second Layer of					See Note 3.4 B	
3.5		Lateral Force Resistance System						
	A.	Concrete Shear Wall In-Plane Flexural					See Note 3.5 A	
3.6		Materials						
	A.	Concrete Condition						
3.7		Equipment Anchorage Capacities						
3.8		Covered Walkways / Canopy						
3.90		Essential Facility				See Note 3.9		
3.10		Roof Assembly and Structure						

NOTES:

3.1 - If the building structure is strengthened, it is anticipated that some footings will prove to be inadequate or will not be located where needed.

3.1 A - At the northwest building corner, the concrete walkway surrounding the entrance level shows approximately 1-1/2 inches of settlement.

3.2 A - The existing concrete columns throughout the structure, at both levels, contain longitudinal reinforcement running vertically. Transverse, confining tie reinforcement around the longitudinal bars has been found to be inadequate in previous studies.

3.3 B - Previous engineering reports state that the existing roof diaphragm shear capacity is exceeded even if the existing roof tile were to be removed and replaced with a lighter roofing material.

3.3 C - Previous structural studies state that the existing roof diaphragm collectors consist of steel roof beams around the perimeter of the structure, and are aligned parallel to and above the upper-level concrete shear walls. These elements collect the seismic forces within the roof diaphragm and deliver the forces to the shear walls. Where splices occur in the lines of steel beams, the connectors are currently not adequate to transfer the required seismic collection forces.

3.4 A - Previous engineering reports state that the current anchor bolts are insufficient to transfer the prescribed forces to the shear walls, even with added shear walls.

3.4 B - Previous structural studies state that when calculated in-plane shear stresses within shear walls exceed a certain threshold, those walls must have two layers of internal reinforcing. The shear walls currently have one layer of reinforcing, which is comprised of vertical and horizontal rebar.

3.5 A - Previous structural studies state that in-plane flexure results from the shear walls bending when resisting seismic loads at their tops. This causes tension and compression at wall ends which increases potential for the wall to fail. Boundary bars are needed to resist these forces.

3.9 - Previous studies by other engineers state that the building was not designed for the higher seismic force levels required to qualify as an Essential Facility. The Emergency Operations Center at City Hall is thus a violation of code as the EOC is an Essential Facility.

GENERAL CONDITION CHECKLIST

			System	Excellent 5	Good 4	Fair 3	Poor 2	Critical 1	N/A
4	**Interior Elements**								
	4.0	General Condition					**2.20**		
	4.1	Ceilings					See Note 4.1		
		A.	ACT				See Note 4.1		
		B.	Drywall			■			
	4.2	Flooring					See Note 4.2		
		A.	Carpet			■			
		B.	VCT				See Note 4.2		
		C.	Tile				See Note 4.2		
	4.3	Stairs					See Note 4.3		
		A.	Landing Finish				See Note 4.3		
		B.	Stair Treads			■			
		C.	Stair Nosings				See Note 4.3		
		D.	Handrails				See Note 4.3		
	4.4	Toilet Rooms					See Note 4.4		
		A.	Restroom Accessories				See Note 4.4		
		B.	Toilet Partitions				See Note 4.4		
		C.	Screen Partitions				See Note 4.4		
		D.	Flooring				See Note 4.4		
		E.	Walls				See Note 4.4		
		F.	Signage				See Note 4.4		
		G.	Water Closets			■			
		H.	Urinals			■			
		I.	Lavatories / Sinks				See Note 4.4		
	4.5	Signage					See Note 4.5		
		A.	Room (Side Mount or Door Head Mount)				See Note 4.5		
		B.	Directional				See Note 4.5		

NOTES:

4.1 - Some ceiling tiles are broken or spotted.

4.2 - The basement flooring is in poor condition, is outdated and in need of replacement. Flooring shows signs of normal wear and tear.

4.3 - Stair treads in lobby exceed 7" height for accessibility. Stairwell treads and wall finishes are scuffed and deteriorated.

4.4 - Toilet room finishes and fixtures show signs of normal wear and tear and are outdated.

4.5 - Toilet room directional signage is inadequate.

GENERAL CONDITION CHECKLIST

System			Condition: Excellent 5	Good 4	Fair 3	Poor 2	Critical 1	N/A
5	**Mechanical, Electrical and Plumbing Systems**							
	5.0	General Condition			2.52			
	5.1	Mechanical Systems						
	A.	Heating and Cooling Systems Overall			■			
	B.	MEP Systems Code					See Note 5.1 B	
	C.	Ventilation					See Note 5.1 C	
	D.	Controls			■			
	E.	Chiller			■			
	F.	Cooling Towers				See Note 5.1 F		
	G.	Boilers					See Note 5.1 G	
	H.	Hot & Cold Water Distribution System				See Note 5.1 H		
	5.2	Plumbing systems						
	A.	Plumbing Fixtures			■			
	B.	Domestic Water System				See Note 5.2 B		
	C.	Backflow Preventer		■				
	D.	Sanitary Collection / Septic System			■			
	5.3	Electrical Systems						
	A.	Utility Transformer		■				
	B.	Main Switchboard				See Note 5.3 B		
	C.	Emergency Generator				See Note 5.3 C		
	D.	Grounding System						■
	5.4	Lighting						
	A.	Interior Lighting			■			
	B.	Lighting Controls		■				
	5.5	Data Systems				See Note 5.5		
	5.6	Gas Distribution Systems			■			

NOTES:

5.1 B - The combination of chiller, gas boiler, electrical gear, and generator equipment do not meet today's code requirement for separate rooms for each of these pieces of equipment. The room is also not equipped with refrigerant detection and an exhaust system, currently required for chiller rooms. The combustion air ducts in the boiler room need to be routed to an outdoor location.

(continued on next page)

GENERAL CONDITION CHECKLIST

System				Condition: Excellent 5	Good 4	Fair 3	Poor 2	Critical 1	N/A
	5.7	Water Heaters				■ (Fair)			
	5.8	Conveying Systems							
		A.	Elevator Machinery Room				See Note 5.8 A		

NOTES: (continued from previous page)

5.1 C - According to ESFA, page 30, the existing AHU's air intake is located in an air well that does not provide good air quality air for building occupants. The amount of fresh air brought into the building is not enough by today's standards, and should be increased and improved.

5.1 F - Previous reports have pointed to the building requiring cooling tower maintenance.

5.1 G - The boiler is original to 1965 and is well past its useful service life.

5.1 H - Previous reports have pointed to the building requiring plumbing system maintenance.

5.2 B - An AO Smith gas fired water heater boiler provides domestic hot water to all building plumbing fixtures.

5.3 B - The main switchboard is rated 1600Amp, 208/120Volt, 3-phase, 4-wire and is located inside the main electrical room. It is feeding a distribution panel via a 1,000Amp breaker. Additional service panels have been installed in the past 10 years to balance the load & provide additional circuits. Some parts of the motor control panels are no longer available & used ones have to be located when necessary.

5.3 C - Previous assessment reports state the emergency power system consists of a diesel generator rated at 125KW, 208/120V and is located inside the main electrical room. The fuel tank is located outside the room. The generator does not serve the existing elevator or the chiller, as confirmed by discussions with facility personnel. The diesel generator was installed in 1978.

5.4 A - The existing lighting system consists mostly of recessed and pendant mounted fluorescent linear T8 32/26 watts source fixtures, with additional recessed incandescent downlight fixtures. Light fixtures appear to date back to the original construction and are in fair condition, with no operational issues. Some have scuff marks or peeling paint.

5.5 - Data systems require attention to reduce confusion.

5.8 A - Elevator machine room walls do not go all the way up to floor slab.

GENERAL CONDITION CHECKLIST

System			Condition					
			Excellent	Good	Fair	Poor	Critical	N/A
			5	4	3	2	1	
6	Fire/ Life Safety							
6.0	General Condition			3.64				
6.1	Occupancy Classification							
6.2	Type of Construction							
6.3	Height							
6.4	Fire Resistive Separations							
6.5	Elevator Shaft Enclosure						See Note 6.5	
6.6	Exit Stair Enclosure							
6.7	Corridors							
6.8	Interior Finishes							
	A.	Wall and Ceiling						
	B.	Floor						
6.9	Means of Egress							
	A.	Occupant Load						
	B.	Egress Width						
	C.	Panic Hardware						
	D.	Vertical Exit Enclosures–Lobby Open Stairs to Basement						
6.10	Fire Supression System							
6.11	Fire Alarm System							

NOTES:

6.5 - The existing elevator shaft may be deficient. The drawing A2.1 (1986 Renovation) indicates "Carry shaft wall to underside of lobby ceiling". Fire barriers need to extend to the underside of the roof sheathing per 707.5 or enclosed at the top with the same fire resistance rating per 708.12. See section 4.5.3 of the 2010 CBC.

GENERAL CONDITION CHECKLIST

System				Condition		
				Compliance	Non-compliance	N/A
6	**ADA Compliance**					
	7.0	General Condition			**Needs Improvement**	
	7.1	Restrooms				
		A.	Accessible Stall Size			
		B.	Countertop Height			
		C.	Toilet Paper Shelf			
		D.	Turn Around			
		E.	Shower			
	7.2	Accessible Entry				
	7.3	Accessible Means of Egress				
	7.4	Accessible Parking Spaces				
	7.5	Counter Heights				
		A.	Counter in lobby			
		B.	Notory Public Receiption Counter			
	7.6	Passenger loading zones				
	7.7	Elevator				
	7.8	Signage				

NOTES:

7.1 A - The width of the accessible stall is smaller than 5'.

7.1 C - The shelf is mounted 2" above the grab bar. The minimum clearance is 12".

7.1 E - Non-Compliant Shower. No directional signs. Does not meet ADA.

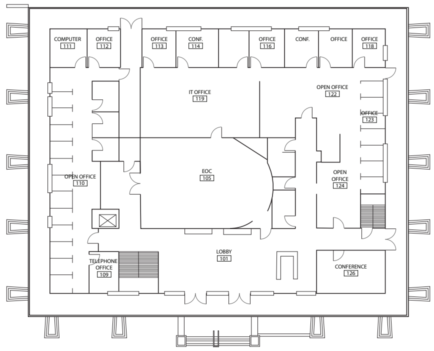
7.3 - Elevator is required if on bottom level for wheelchair access which is not ADA compliant. Accessible egress is easiest through means of lobby

7.5 B - The height of the countertop is 42". The height of countertop needs to be between 28' and 34".

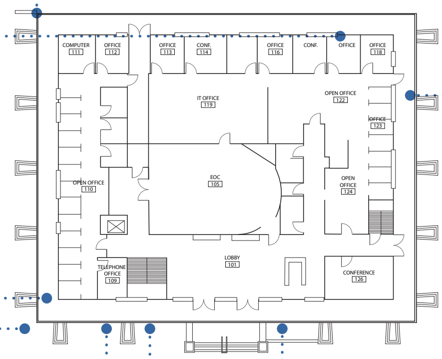
7.6 - City Hall has an inappropriate loading zone.

7.7 - Every building which has elevators must have at least one passenger elevator that meets ADA's accessibility requirements. The existing elevator cabin does not allow a wheelchair user to enter, maneuver, reach the controls and then turn around to exit the elevator.

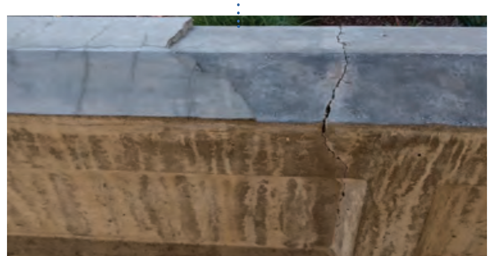
7.8 - Accessibility signage requires upgrades to meet current code requirements.

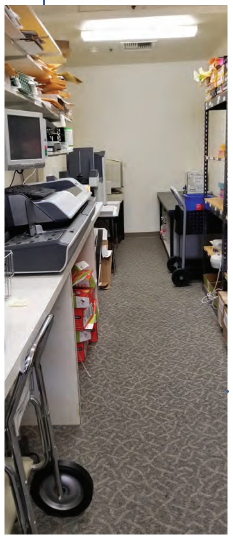


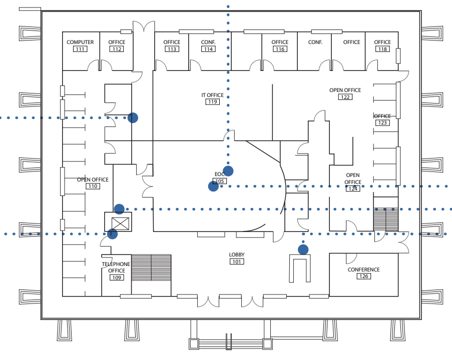
first floor plan



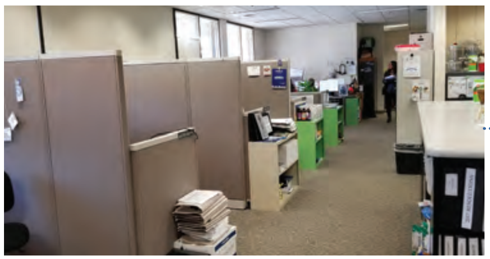
first floor plan

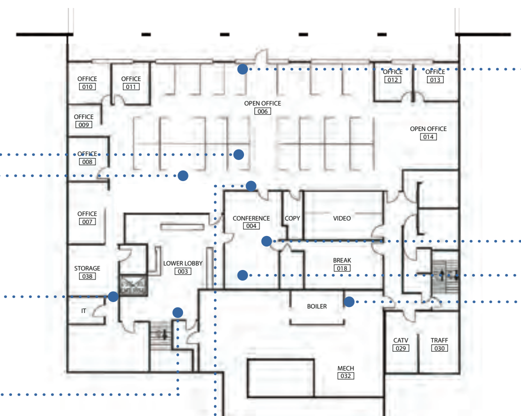




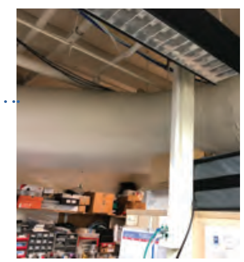


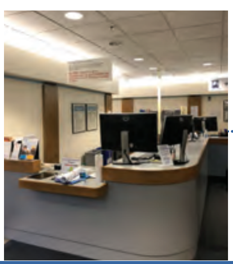
first floor plan

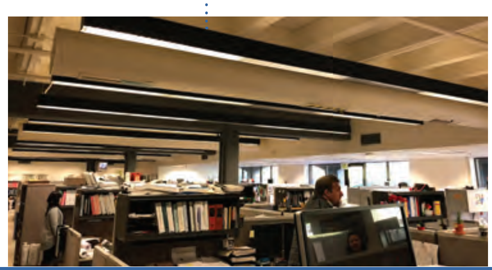


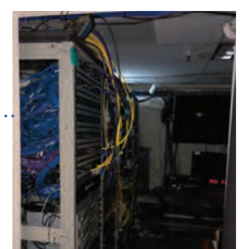


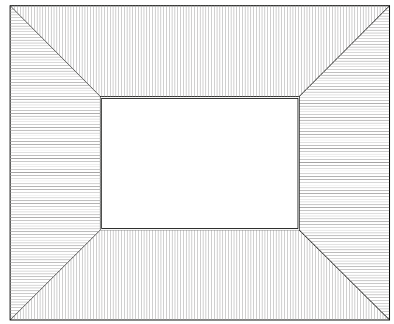
basement plan



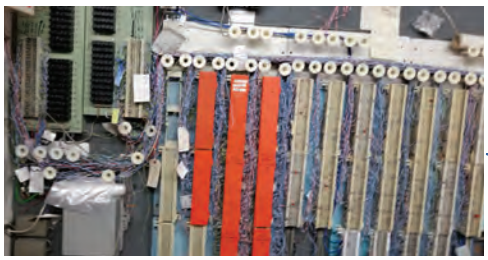


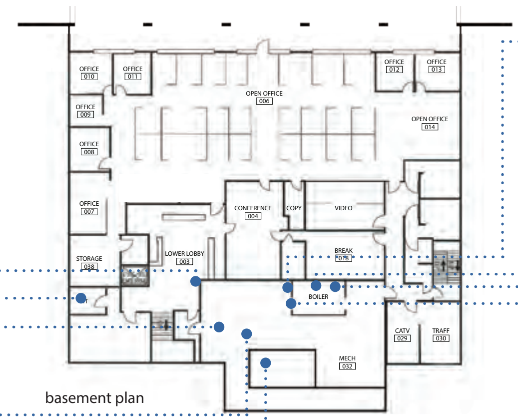




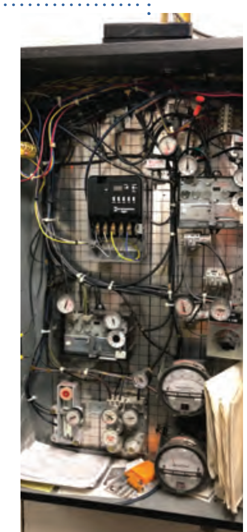


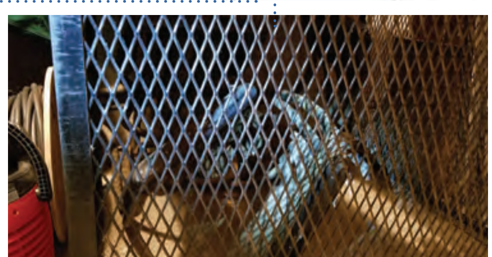
roof plan





basement plan





Building Component			Condition		Findings	Recommendations
1	Site/ Civil/ Landscape					
	1.0	General Condition		**3.59**		
	1.1	Perimeter Fencing	3	Fair	There is perimeter fencing along the creek on the east side of the City Hall property that is in fair condition.	Maintain perimeter fencing accordingly.
	1.2	Equipment / Stormwater Fencing	4	Good	Catch basins at parking lots, perimeter road, curb and gutters.	These systems are operating normally. None
	1.3	On-Site Sidewalks / Crosswalks	3	Fair	Sidewalks have a 1.5% side slope. Some small chips of concrete are missing on sidewalks.	Repair chips. Overall site accessibility compliance requires considering additional improvements.
	1.4	Paving	3	Fair	Parking lot has a concrete curb. Parking lots were overlayed and restriped in 2007.	Maintain accordingly.
	1.5	Striping / Markings / Speed Bumps	4	Good	Speed bumps present in parking lot. Striping is in fair condition. Curb painting is faded.	Normal maintenance and replacement of paint and markings as necessary to maintain good striping condition.
	1.6	Curbing	3	Fair	Normal wear and tear. Some curbs show cracks. Some curbs broken at corners.	Replace cracked curbing or repair with epoxy.
	1.7	On-Site Signage	3	Fair	Building signage is present at three sides. Concrete "Cupertino Civic Center" signs located at parking lot entry near Rodrigues Avenue. Both signs are in good condition. Building signs on the west side of building need repair.	Replace signage on the west side of the building.
	1.8	Pedestrian Access (ADA & Safety)	3	Fair	Good access from public sidewalks and streets. See previous ADA reports.	Minor improvements may be necessary.
	1.9	Exterior Furniture	3	Fair	Concrete benches and wooden benches are present at the main site walkway. Movable furniture for employee use is provided at basement patio. New stone seating area in is located at west landscape.	Replace cracked or faded furniture.
	1.10	Bike Racks / Storage	4	Good	On site bike locker. Both hoop racks and enclosed bike racks. Good condition. Bike storage is lockable.	None

Building Component			Condition		Findings	Recommendations
1	**Site/ Civil/ Landscape**					
	1.11	Irrigation System	4	Good	Irrigation system is new in 2017.	None
	1.12	Landscape Vegetation	4	Good	Heavily landscaped site with trees and ground vegetation. Landscape new in 2017.	None
	1.13	Landscape Walls / Structures	4	Good	Concrete pergola/ walkway connecting two buildings.	None
	1.14	Trees and Shade Systems	4	Good	Building has full perimeter overhang.	None
	1.15	Electrical Service	4	Good	Site transformer. A larger PG&E transformer installed around 2010.	None
	1.16	Gas Distribution System	4	Good	No gas main concerns noted.	None
	1.17	Storm Water Management	4	Good	Storm sewr to street collects landscape drainage systems.	None

Building Component				Condition		Findings	Recommendations
2	Exterior Envelope						
	2.0	General Condition			**2.59**		
	2.1	General Appearance		3	Fair	The exterior envelope is in fair condition with some deteriorated wood and cracking concrete elements. Eaves contain evidence of wasps.	Maintain City Hall exterior envelope accordingly.
	2.2	Exterior Finish		2	Poor	8" painted boards. Roof fascia boards are cracked, warped, peeling & need repair.	Repaint or replace cracked and peeling boards.
	2.3	Covered Walkways/ Canopy		2	Poor	Connection to Civic Center with overhead canopy is in good condition. Covered walkways around building are dusty. Concrete railing surrounding the building underneath the upper level covered walkway is in poor condition with many cracks.	Repair concrete railing surrounding the building. Clean connection and covered walkways.
	2.4	Doors/ Windows/ Louvers					
		A.	Windows	1	Critical	Fixed full-size aluminum windows. Single pane windows. One window on the east wall has a bad seal.	Replace single - pane windows with double-pane windows and reseal deteriorated seals.
		B.	Louvers and Vents	3	Fair	Louvers and vents show more than normal wear and tear.	Replace louvers and vents when necessary.
		C.	Main Entry Doors & Hardware	3	Fair	Main aluminum entry doors and hardware are in fair condition with signs of more than normal wear and tear.	Replace as desired.
		D.	Other Exterior Doors & Hardware	3	Fair	Other aluminum entry doors and hardware are in fair condition with signs of more than normal wear and tear.	Replace as desired.
	2.5	Exterior Walls		3	Fair	Exterior concrete walls are in fair condition with slight discoloration and weathering. Exterior painted wood siding is in fair condition.	Maintain accordingly. Consider washing concrete and repainting building exterior.
	2.6	Waterproofing		3	Fair	No exterior waterproofing issues were observed or reported.	Further investigate waterproofing during any maintenance or repairs to exterior building elements.
	2.7	Soffits		2	Poor	Soffits are dusty. Mud observed on west/east walls at soffit.	Repaint and repair soffits. Replace deteriorated wood.

Building Component				Condition		Findings	Recommendations
2	**Exterior Envelope**						
	2.8	Roofing					
		A.	Condition Rating	3	Fair	Clay tile roofing has some broken tiles and is dusty.	Replace broken tiles and clean roof. Replace clay tiles with different roofing material if structural enhancements to support clay tiles are not performed.
		B.	Roof Opening (Access)	2	Poor	Straight ladder to roof has elements that should be resecured.	Improve safety at ladder.
		C.	Roof Equipment Curbing	2	Poor	Rooftop equipment curbing is in poor condition and shows signs of rust, mildew and deterioration. This could be a non-structural seismic hazard.	Replace roof equipment curbing when rooftop equipment is replaced.
		D.	Leakage	4	Good	Major roofing repair done around 2005. Leak above IT department repaired in 2017. Waterproofing seals at seams on metal caps on roof parapet are cracked & needs replacement.	Repair or replace waterproofing seals at seams and roof parapet.
		E	Ponding water	2	Poor	Some water is pooling under rooftop equipment. Some water is pooling near water tower.	Upon next re-roof, increase slope at tapered insulation to improve water drainage.
		F.	Roof Drainage	3	Fair	Roof drains are clear but rusty and starting to deteriorate.	Recommend catch basins for all gutter drains. Replace rusty roof drains.
		G.	Gutters / Downspouts	3	Fair	Gutters and downspouts are in good condition, but they drain onto the basement patio area which causes staining and slower water infiltration back into the ground.	Remodel gutters to spill into dirt area.

Building Component				Condition		Findings	Recommendations
3	**Structure**						
	3.0	General Condition			**2.15**	The City Hall building structure is two story with an entry level and a basement level. The clay tile roof slopes down from a central mansard over a taller space. There is an arcade/walkway under the eave on all four sides. The construction is wood framing over a concrete basement. Columns are concrete as are the lateral force resisting shear walls. The first floor is concrete pan joists and girders supported on concrete columns and walls. The basement floor is concrete slab on grade.	Upgrade structural systems and capacity to meet current roof loads and lateral force requirements. Refer to the following items for detailed recommendations.
	3.1	Foundation/ Footing		**2**	Poor	If the building structure is strengthened, it is anticipated that some footings will prove to be inadequate or will not be located where needed.	Provide adequate footings, helical piers and/or micropiles at appropriate locations.
		A.	Settlement	**2**	Poor	At the northwest building corner, the concrete walkway surrounding the entrance level shows approximately 1-1/2 inches of settlement.	Mudjacking is a common solution for such a problem.
	3.2	Columns					
		A.	Concrete Column Reinforcement for Confinement	**2**	Poor	The existing concrete columns throughout the structure, at both levels, contain longitudinal reinforcement running vertically. Transverse, confining tie reinforcement around the longitudinal bars has been found to be inadequate in previous studies.	Jacket existing columns with either Fibre-Wrap or reinforced concrete.

Building Component				Condition		Findings	Recommendations
3	**Structure**						
	3.3	Framing System					
		A.	Wood Framing Condition	4	Good	Generally speaking, the wood framing that is visible is in good condition.	During removal of drywall at renovatinos, check condition and connections.
		B.	Roof Diaphragm Shear Capacity	1	Critical	Previous engineering reports state that the existing roof diaphragm shear capacity is exceeded even if the existing roof tile were to be removed and replaced with a lighter roofing material.	The plywood diaphragm can be strengthened as needed with added panel edge nailing near the perimeter of the building. Alternative: A second layer of plywood may be added to further enhance the lateral force resistance.
		C.	Roof Diaphragm Collector Splice Capacity	2	Poor	Previous structural studies state that the existing roof diaphragm collectors consist of steel roof beams around the perimeter of the structure, and are aligned parallel to and above the upper-level concrete shear walls. These elements collect the seismic forces within the roof diaphragm and deliver the forces to the shear walls. Where splices occur in the lines of steel beams, the connectors are currently not adequate to transfer the required seismic collection forces.	Provide welding around the splice plates to the beams at the splice connections.
	3.4	Walls					
		A.	Anchor Bolt Connections at top of Shear Walls	2	Poor	Previous engineering reports state that the current anchor bolts are insufficient to transfer the prescribed forces to the shear walls, even with added shear walls.	Provide adequate anchor bolts to any new walls. Provide additional anchor bolts through the existing beams, between the existing anchor bolts, to strengthen the shear-transfer connections sufficiently.
		B.	Concrete Shear Wall Second Layer of Reinforcing	1	Critical	Previous structural studies state that when calculated in-plane shear stresses within shear walls exceed a certain threshold, those walls must have two layers of internal reinforcing. The shear walls currently have one layer of reinforcing, which is comprised of vertical and horizontal rebar.	Add a second layer of reinforced concrete to the shear walls and/or add additional concrete shear walls.

Building Component				Condition		Findings	Recommendations
3	**Structure**						
	3.5	Lateral Force Resistance System					
		A.	Concrete Shear Wall In-Plane Flexural Capacity	1	Critical	Previous structural studies state that in-plane flexure results from the shear walls bending when resisting seismic loads at their tops. This causes tension and compression at wall ends which increases potential for the wall to fail. Boundary bars are needed to resist these forces.	Add boundary elements to the shear walls with sufficient ties to preclude buckling.
	3.6	Materials					
		A.	Concrete Condition	3	Fair	Generally speaking the concrete work that is visible is in good condition. The exception is a concrete railing on the west side of the building which is cracked.	Repair cracked concrete via epoxy.
	3.7	Equipment Anchorage Capacities			Not studied	The capacity of the equipment anchorage throughout the building is unknown and warrants a survey of existing on-site conditions, as well as any drawings available that address the methods of anchorage and lateral bracing.	Replace deteriorating equipment anchorages. Install additional anchorage as required.
	3.8	Covered Walkways / Canopy		3	Fair	Covered walkways show signs of normal wear and tear. Concrete perimieter fencing along the first level is cracked and deteriorating in places.	Repair concrete perimter fencing.
	3.9	Essential Facility		2	Poor	Previous studies by other engineers state that the building was not designed for the higher seismic force levels required to qualify as an Essential Facility. The Emergency Operations Center at City Hall is thus a violation of code as the EOC is an Essential Facility.	Strengthen the building so that the EOC may be brought back to City Hall, if desired.
	3.10	Roof Assembly and Structure		3	Fair	A roof assembly is required to meet Class A fire test exposure in accordance with the City ordinances. The existing roof equipment shows an incomplete attachment mechanism to the roof deck.	Strenghthen roof assembly and replace equipment attachments.

Building Component				Condition		Findings	Recommendations
4	**Interior Elements**						
	4.0	General Condition			**2.20**		
	4.1	Ceilings		2	Poor	Some ceiling tiles are broken or spotted.	Replace ceiling tiles.
		A.	ACT	2	Poor		
		B.	Drywall	3	Fair		
	4.2	Flooring		2	Poor	The basement flooring is in poor condition, is outdated and in need of replacement. Flooring shows signs of normal wear and tear.	Replace basement flooring and consider replacement of other flooring throughout the facility.
		A.	Carpet	3	Fair		
		B.	VCT	2	Poor		
		C.	Tile	2	Poor		
	4.3	Stairs		2	Poor	Stair treads in lobby exceed 7" height for accessibility. Stairwell treads and wall finishes are scuffed and deteriorated.	Renovate stairs to provide compliant riser height.
		A.	Landing Finish	2	Poor		
		B.	Stair Treads	3	Fair		
		C.	Stair Nosings	2	Poor		
		D.	Handrails	2	Poor		
	4.4	Toilet Rooms		2	Poor	Toilet room finishes and fixtures show signs of normal wear and tear and are outdated.	Replace toilet room finishes and fixtures.
		A.	Restroom Accessories	2	Poor		
		B.	Toilet Partitions	2	Poor		
		C.	Screen Partitions	2	Poor		
		D.	Flooring	2	Poor		
		E.	Walls	2	Poor		
		F.	Signage	2	Poor		
		G.	Water Closets	3	Fair		
		H.	Urinals	3	Fair		
		I.	Lavatories	2	Poor		
	4.5	Signage		2	Poor	Toilet room directional signage is inadequate.	Install adequate toilet room directional signage.
		A.	Room	2	Poor		
		B.	Directional	2	Poor		

Building Component				Condition		Findings	Recommendations
5	**Mechanical, Electrical and Plumbing Systems**						
	5.0	General Condition			**2.52**		
	5.1	Mechanical Systems					
		A.	Heating and Cooling Systems Overall	3	Fair	The HVAC system consists of a water-cooled chiller plant (70 Ton) with the cooling tower located on the roof and the chiller located on the lower level. A gas fired non-condensing boiler generates heating for the building's hot water. The boiler is from 1965, original to the building and is well past its useful service life. Both of these systems provide chilled and hot water to the Air Handling Units (AHU's) located at the lower level which in turn heat and cool the building through a variable air volume (VAV) reheat design. Except for the boiler, most major HVAC components are now 32 years old and at the end of service life.	New HVAC system for building. alternative 1: Upgrade all duct, pipe, and equipment anchorage and seismic attachments to building structure. Replace duct and pipe connections with flexible joints where required. Air coils on various split air AC units need to be serviced (dirty coils). alternative 2: Replace existing HVAC equipment with smaller, more efficient, more comfortable equipment.
		B.	MEP Systems Code	1	Critical	The combination of chiller, gas boiler, electrical gear, and generator equipment do not meet today's code requirement for separate rooms for each of these pieces of equipment. The room is also not equipped with refrigerant detection and an exhaust system, currently required for chiller rooms. The combustion air ducts in the boiler room need to be routed to an outdoor location.	Separate rooms for mechanical and electrical equipment. Install exhaust systems where required.
		C.	Ventilation	1	Critical Inmediate Funding	According to ESFA, page 30, the existing AHU's air intake is located in an airwell that does not provide good air quality air for building occupants. The amount of fresh air brought into the building is not enough by today's standards, and should be increased and improved.	Obtain fresh air from a different location (i.e. roof louvers) and increase amount of fresh air for the building.

Building Component				Condition		Findings	Recommendations
5	**Mechanical, Electrical and Plumbing**						
	5.1	Mechanical Systems					
		D.	Controls	3	Fair	The existing HVAC control system is an outdated pneumatic system that does not allow for remote monitoring or the implementation of common energy efficiency strategies found in modern buildings. In addition, the pneumatic control system requires more maintenance for the compressor, air filter and other upkeep.	Replace existing pneumatic system with modern digitally controlled system.
		E.	Chiller	3	Fair	The main chiller control panel was damaged in 2016 due to a voltage surge and the chiller is currently being retrofitted with a new unit. Previous reports have discovered that one side of the chiller is not working. The freon pop off valves on the chiller need to be vented outside the building.	Replace chiller controls and increase ventilation outside building.
		F.	Cooling Towers	2	Poor	Previous reports have pointed to the building requiring cooling tower maintenance.	No additional comments noted.
		G.	Boilers	1	Critical	The boiler is original to 1965 and is well past its useful service life.	Replace boiler with new energy efficient unit.
		H.	Hot & Cold Water Distribution System	2	Poor	Previous reports have pointed to the building requiring plumbing system maintenance.	

Building Component				Condition		Findings	Recommendations
5	**Mechanical, Electrical and Plumbing**						
	5.2	Plumbing Systems					
		A.	Plumbing Fixtures	3	Fair	Plumbing fixtures could use replacement but seem to be functioning properly.	Replace fixtures if desired. Inspect piping for leaks.
		B.	Domestic Water System	2	Poor	An AO Smith gas fired water heater boiler provides domestic hot water to all building plumbing fixtures.	Plumbing system should be further studied for optimal knowledge and repair plan.
		C.	Backflow Preventer	4	Good	Backflow preventer is serviced yearly.	Continual annual maintenance to backflow preventer.
		D.	Sanitary Collection / Septic System	3	Fair	City Sewer. Sewer lines in the ceiling above the video department desks have rust & pitting.	Plumbing system should be further studied for optimal repair. Replace deteriorated sewer lines as soon as possible.

Building Component				Condition		Findings	Recommendations
5	**Mechanical, Electrical and Plumbing**						
	5.3	Electrical Systems					
		A.	Utility Transformer	4	Good	The building is fed from a PG&E transformer located outside the building. Secondary power from the transformer to the main switchboard is provided via four sets of 4" underground conduit. PG&E transformer upgraded around 2010.	Connect transformer to new electrical system and switch.
		B.	Main Switchboard	2	Poor	The main switchboard is rated 1600Amp, 208/120Volt, 3-phase, 4-wire and is located inside the main electrical room. It is feeding a distribution panel via a 1,000Amp breaker. Additional service panels have been installed in the past 10 years to balance the load & provide additional circuits. Some parts of the motor control panels are no longer available & used ones have to be located when necessary.	Upgrade existing main switchboard and replace motor controls with a new modern switchboard.
		C.	Emergency Power	2	Poor	Previous assessment reports state the emergency power system consists of a diesel generator rated at 125KW, 208/120V and is located inside the main electrical room. The fuel tank is located outside the room. The generator does not serve the existing elevator or the chiller, as confirmed by discussions with facility personnel. The diesel generator was installed in 1978.	The diesel generator should be removed from the basement. Emergency power should be provided from an exterior location. Interior fuel piping to generator location should be removed. If natural gas or propane is used, eliminate the fuel tanks.
		D.	Grounding System		Not studied	According to previous assessment reports, the service ground was not readily visible at the Main Switchboard. Feeder and branch circuit ground conductor sizes were not verified. Bonding to the building mechanical systems was not confirmed.	Requires additional survey.

Building Component				Condition		Findings	Recommendations
5	**Mechanical, Electrical and Plumbing**						
	5.4	Lighting					
		A.	Interior Lighting	3	Fair	The existing lighting system consists mostly of recessed and pendant mounted fluorescent linear T8 32/26 watts source fixtures, with additional recessed incandescent downlight fixtures. Light fixtures were replaced in 1986 renovation, and are in fair condition, with no operational issues. Some have scuff marks or peeling paint.	Retrofit all tube style lighting fixtures with the installation of lateral bracing. Alternative 1: Perform functional testing of all existing emergency lighting and measure light levels for code compliance. Install additional emergency lighting as necessary after the functional testing of the existing installation to provide current code required minimum egress illumination. Alternative 2: Replace existing lighting fixtures with a new lighting system including fixtures for a remodeled building.
		B.	Lighting Controls	4	Good	According to previous assessmen reports, the existing general lighting is controlled by local switches located within the corridors and at the each room. Lighting in the kitchen, bathrooms, stairwell and conference room “A” is controlled by motion sensors. Relay control panels provide time schedule control for corridors and general areas, and dimming equipment provides dimming functionality to meeting rooms.	Install smart lighting systems for better energy performance.
	5.5	Data Systems		2	Poor	Data systems require attention to reduce confusion.	Upgrade existing data systems.
	5.6	Gas Distribution Systems		3	Fair	No problems reported with gas distribution system. Diesel fuel lines present to feed emergency generator.	Interior fuel piping to generator location should be removed.
	5.7	Water Heaters		3	Fair	Domestic hot water heater installed around 2000.	Consider replacing hot water heater as the existing unit is at the end of its useful service life.

REPORT TABLE

Building Component				Condition		Findings	Recommendations
5	**Mechanical, Electrical and Plumbing**						
	5.8	Conveying Systems					
		A.	Elevator Machine Room	2	Poor	Elevator machine room walls do not go all the way up to floor slab.	Renovate existing wall to extend to floor slab and upgrade existing elevator. Alternative: Rebuild existing elevator machine room as part of remodel for City Hall.

Building Component				Condition		Findings	Recommendations
6	**Fire and Life Safety**						
	6.0	General Condition			**3.64**		
	6.1	Occupancy Classification			N/A	B Occupancy	N/A
	6.2	Type of Construction			N/A	The type of construction is Type V-B with an automatic sprinkler system throughout.	N/A
	6.3	Height			N/A	The allowable building area is 34,800 SF and the built area is 11,520 SF per story.	N/A
	6.4	Fire Resistive Separations		4	Good	Fire resistive separations are in good condition with the exception of the elevator shaft enclosure. See rating 5.8.	Maintain fire resistive separations accordingly.
	6.5	Elevator Shaft Enclosure		1	Critical	The existing elevator shaft is deficient. The drawing A2.1 (1986 Renovation) indicates "Carry shaft wall to underside of lobby ceiling". Fire barriers need to extend to the underside of the roof sheathing per 707.5 or enclosed at the top with the same fire resistance rating per 708.12. See section 4.5.3 of the 2010 CBC.	Correct code deficiency.
	6.6	Exit Stair Enclosure			Not studied in detail	The exit stair enclosure wall needs to be a 1-hour Fire Barrier with a 1-hour rated opening. The existing door on the first floor is labeled as 60-minute. The rating of the door on the basement was not legible	Modify where required to meet code.
	6.7	Corridors		4	Good	The building's corridors are not required to be separated by fire or smoke partitions because the existing building is A and B Occupancy and equipped with a fire sprinkler system.The existing corridors open to the public area are rated per the 1986 drawings. The existing openings between the west corridor and the office area are allowed per the current code.	None
	6.8	Interior Finishes					
		A.	Wall and Ceiling	4	Good	Corridors serving the egress of the EOC, West Corridor, Lobby, and South Corridor require Class B finishes on the walls and ceiling. The existing finish materials need to be further examined to confirm that they meet ASTM E-84 Class B frame spread rating and the ASTM C 635 or C636 for suspended acoustical ceilings.	None
		B.	Floor	4	Good	Class I or II interior floor finish is required in all exit routes.	None

Building Component				Condition		Findings	Recommendations
6	**Fire and Life Safety**						
	6.9	Means of Egress					
		A.	Occupant Load	4	Good	The occupancy load of first floor is 197 and basement is 124 per Cupertino City Hall Essential Services Facility Analysis. The existing layout provides working space for 100 staff.	None
		B.	Egress Width	4	Good	All existing doors and corridors currently provide more than the required egress width.	None
		C.	Panic Hardware	4	Good	Panic hardware is in good condition.	Maintain accordingly.
		D.	Vertical Exit Enclosures–Lobby Open Stairs to Basement	4	Good	Open stairs are allowed.	None
	6.10	Fire Supression System		3	Fair	A fire sprinkler is used and checked yearly but is antiquated and is in need of replacement.	Maintain accordingly and replace fire supression system with new when necessary.
	6.11	Fire Alarm System		4	Good	An audible & flashing fire alarm system is used & monitored by Sonitrol & checked yearly. A new fire riser was installed in 2017.	Maintain accordingly

Building Component				Condition		Findings	Recommendations
7	ADA Compliance						
	7.0	General Condition			Needs Improvement		
	7.1	Restrooms					
		A.	Accessible Stall Size		Non-Compliance	The width of the accessible stall is smaller than 5'.	Retrofit accessible stall to provide ADA compliance.
		B.	Countertop Height		Compliance	The heights of the countertops in bathrooms are more than 28" and less than 34".	Maintain accordingly.
		C.	Toilet Paper Shelf		Non-Compliance	The shelf is mounted 2" above the grab bar. The minimum clearance is 12".	Retrofit toilet paper shelf to 12" height above grab bar to provide ADA compliance.
		D.	Turn Around		Compliance	The turn around diameter is above 5'.	Maintain accordingly.
		E.	Shower		Non-Compliance	Non-Compliant Shower. No directional signs. Does not meet ADA.	Retrofit shower to provide ADA compliance or eliminated existing showers since they are not required by code. The space can be use to provide additional water closets. See code review for additional information. Provide directional signage.
	7.2	Accessible Entry			Compliance	Access meets code and ADA requirements. Ramps provide access to first floor.	Maintain accordingly.
	7.3	Accessible Means of Egress			Non-Compliance	Elevator is required if on bottom level for wheelchair access which is not ADA compliant. Accessible egress is easiest through means of lobby	Upgrade elevator or provide new compliant elevator.
	7.4	Accessible Parking Spaces			Compliance	Two accessible parking spaces are provided	Consider providing additional accessible parking spaces.
	7.5	Counter Heights					
		A.	Counter in lobby		Compliance	The main counter is not accessible but there is a counter with height of 34"	Maintain accordingly.
		B.	Notory Public Receiption Counter		Non-Compliance	The height of the countertop is 42". The height of countertop needs to be between 28' and 34".	Make a portion of the notary counter ADA accessible.
	7.6	Passenger loading zones			Non-Compliance	City Hall has an inappropriate loading zone and violates code with no access aisles.	Install access aisle at loading zone.
	7.7	Elevator			Non-Compliance	Every building must have at least one passenger elevator that meets ADA's accessibility requirements. The existing elevator cabin does not allow a wheelchair user to enter, maneuver, reach the controls and then turn around to exit the elevator.	Elevator requires upgrade to meet ADA.

Building Component			Condition		Findings	Recommendations
	7.8	Signage		Non-Compliance	Accessibility signage requires upgrades to meet current code requirements.	Install new signage.

ADDITIONAL INFORMATION

	Subject		2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
1	**Building Description**					
	1.1	1 above grade story with 1 below grade basement	Table 503	Table 504.4	The allowable story number is 1 above grade without a sprinkler system for for A-3 occupancy category. It may be located on the first or basement floors based on access to exits.. B occupancy floor numbers are not limited to 2 without a sprinklered building.	Yes
2	**Building Height & Stories**					
	2.1	Height to top of roof: 20'-11 ½" @ top of beam, 26' @ top of parapet	Table 503	Table 504.3 508.3.2	The allowable building height for occupancy A is 40 feet and 1-story. The allowable building area and height of the building is based on the most restrictive allowances for the occupancy groups.	Yes
3	**Building Separations**					
	3.1	Fire Separation Distance				
		East: 174 ft	Table 602	Table 602	Exceeds 30 Feet	Yes
		West: 60+ ft (60 ft to PRW)	Table 602	Table 602	Exceeds 30 Feet	Yes
		North: 60+ ft (60 ft to PRW)	Table 602	Table 602	Exceeds 30 Feet	Yes
		South: 103 ft (to 1964 PL)	Table 602	Table 602	Exceeds 30 Feet	Yes
4	**Nonseparated Mixed-Used Occupancy**					
	4.1	Nonseparated Occupancy B Occupancy and A3 Occupancy		508.3	The building complies with all the provisions of Section 508.3 and shall be considered as nonseparated occupancies.	Yes
5	**Occupancy Load**					
	5.1	First Floor Occupancy A3: 87 First Floor Occupancy B: 78 Basement Occupancy A3: 0 Basement Occupancy B: 82 Total Occupancy Load: 247	508.4	Table 508.2 508.3	If the Council Room is re-purposed for a B Occupancy, then entire building may be classified B vs. nonseparated mixed-use and limitations of A3 occupancies removed.	Yes

	Subject		2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
6	**Approximate Building Area**					
	6.1	Level 1: 11,520 sf Basement: 11,520 sf Total: 23,040 sf		Table 506.2.2	The allowable building area is 34,800 sf. The area was determined in accordance with the applicable provisions of section 508.1. The more restrictive occupancy A3 was used for our area calculations.	Yes
7	**Type of construction**					
	7.1	Type V-B (fully sprinklered)		903.2.1.3, Table 903.2.11.6	Required to provide the current floor area. The building falls within limits for non-sprinklered buildings for height and story number - see Heights and Stories Section.	Yes
8	**Fire Resistive Requirements** – Type V (fully-sprinklered)					
	8.1	Structural Frame: 0 hrs	Table 601 & 602	Table 601	Fire separation distance exceeds 30 feet. No fire-rated walls are required.	Yes
	8.2	Walls Fire-Rating Requirement Bearing Walls Exterior = 0 hrs Interior = 0 hrs Non-Bearing Walls Exterior = 0 hrs Interior = 0 hrs		Table 601	Fire separation distance exceeds 30 feet. No fire-rated walls are required.	Yes
9	**Fire Resistive Separations**					
	9.1	Separations between B and A3 Occupancies		508.3.3	No separation is required between nonseparated occupancies.	Yes
	9.2	MEP Rooms	508.2	509.4	One hour fire barrier is required for MEP room. The existing wall construction meets the current code requirements.	Yes
	9.3	Elevator Machinery Room		3005 & 707	The elevator machinery room walls do not comply with section 707 for fire barriers.	No

	Subject		2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
10	**Exterior Walls**					
	10.1	Opening allowed in exterior walls				
		Max area of exterior wall openings allowed: No Limit Fire Separation distance is > 30′	Table 705.8	Table 705.8	No limit to the openings.	Yes
	10.2	Parapets: not required – exterior wall is not required to be rated.	705.11	705.11.1	Parapets should have the same fire resistance as the required for the supporting wall. Fire barrier wall requirement is zero hours.	Yes
11	**Interior Walls**					
	11.1	Fire Barriers – separating B & A3 occupancy around fmr. Council Room	707		Separation between A and B occupancies is not required. In additon, fire-rated walls are not required for a Type V - Fully Sprinklered building. See previous comments.	Yes
		Extend from the top of the floor 0 ceiling assembly below to the underside of the floor or roof sheathing.	707.5			
		Openings are limited to 25 % of length of wall				
		Openings are not limited to 156sf if fully-sprinklered	707.6			
		Opening protection	707.6 exc 1			
		Wall Type: 1-hr shaft / exit enclosures Opening				
		Wall Type: fire barrier Opening Rating: 45 min.	Table 715			
	11.2	Shaft Enclosures – exit stairs, elevator hoist way	708	713.4	Fire resistance rating of one hour.	
		Enclosures to have fire barrier with 1-hr fire resistance rating	708.4	713.4	Fire resistance rating of one hour.	
		Openings limits are not applicable for for exit enclosures	707.6	713.4	Doors shall be self-closing by smoke detection. More information needed.	Yes

	Subject		2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
11	**Interior Walls**					
	11.3	Corridors – Not required to be separated by fire or smoke partitions in A and B occupancy if fully sprinklered.	Table 1018.1	Table 1020.1	Not required.	Yes
	11.4	Enclosed Elevator Lobby				
		Not required not more than 3 stories in Group B.	708.14.1 Ex. 4	3006.2	Not required.	Yes
		Not required for A where the building is fully-sprinklered.	708.14.1	3006.2	Not required.	Yes
12	**Penetrations**					
	12.1	Through-penetration fire stop systems protecting wall penetrations shall have an F rating or equal to the rated wall.	713.3.1.2	714.3.1.2	No fire separation or service walls.	Yes
	12.2	Through-penetration fire stop systems protecting rated horizontal assemblies shall have an F and a T rating of 1 hour or equal to the rated assembly.	712.4.1.1.2	714.3.1.2	No fire separation or service walls.	Yes
13	**Interior Finishes**		**803.1**			
	13.1	Flame spread requirements for B	Table 803.9	803.11	Interior finishes most likely comply with requirements.	Yes
		Exit Enclosures & Exit Passway: B				
		Corridors: C				
		Rooms and Enclosed Spaces: C				
	13.2	Flame spread requirements for A3	Table 803.9	803.11		Yes
		Exit Enclosures & Exit Passway: B				
		Corridors: B				
		Rooms and Enclosed Spaces: C				

		Subject	2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
14	**Automatic Sprinkler System**		**903.2.1.3**			
15	**Means of Egress**					
	15.1	Occupant Load	Table 1004.1.1	Table 1004.1.2	See previous comments and refer to attached diagrams.	Yes
	15.2	Egress width	1004	100.4.1	See below.	Yes
		Basement				
		Total Occupant Load = 82 Req. Exit Width = 82 X .2 = 16.4 in. Existing Exit Width = 36 in. Req. Stair Width = 82 (.3) = 25 in. Existing Stair Width = 44 in.	1004.4	100.4.1	36 in. > 16.4 in. 44 in. > 25 in.	
		First Floor				
		Total Occupant Load = 272 Req. Exit Width = 272 X .2 = 54 in. Existing Exit Width = 288 in.	1004.4	100.4.1	288 in. > 54 in.	
	15.3	Accessible means of egress	1007.1 Ex 1	1009.1	Accessible means of egress is required in buildings. The building provides an accessible means of egress at the ground level but the elevator is non-compliant and so an accessible means of egress from the basement level is not provided.	No
	15.4	Doors				
		Shall have a clear width of at least 32 in and no door leaf shall be greater than 48 in.	1008.1.1		All egress door widths comply with requirements.	Yes
		Doors shall swing in direction of egress travel where serving a room or area containing an occupancy load of more than 50.		1010.1.2.1	Lower level door was renovated to swing in direction of path of travel.	Yes
	15.5	Panic hardware is required on exit doors from				
		Assembly (A) occupancies	1008.1.10	1010.1.10	Panic hardware is provided.	Yes

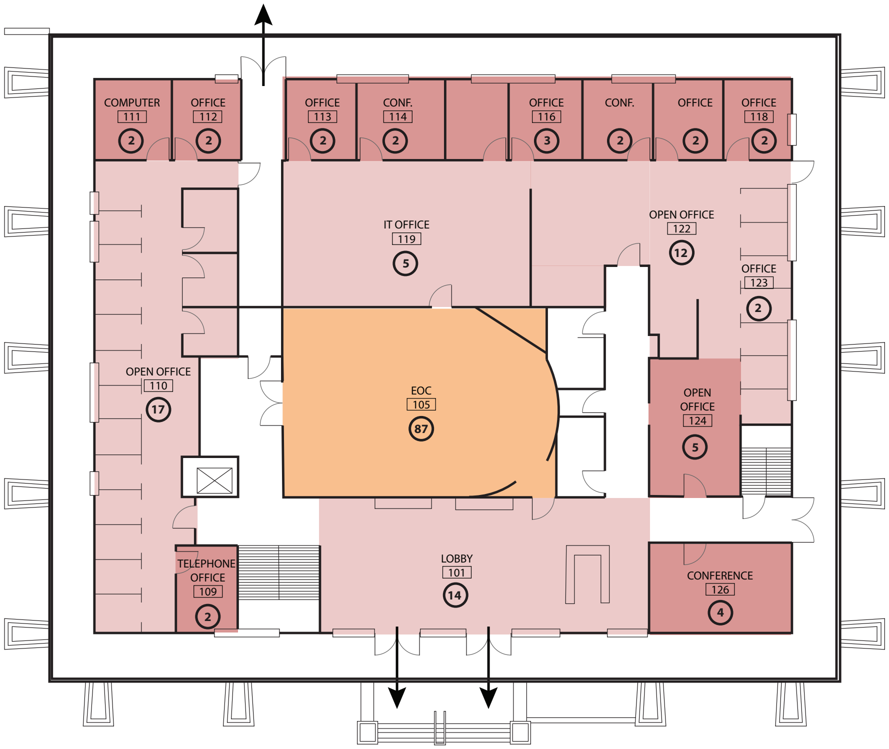
	Subject		2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
15	**Means of Egress**					
	15.6	Stairways				
		Minimun required width is 44 in.	1009.1	1011.2	Existing stair width is 44 in.	Yes
		Handrails	1012	1011.11	Handrails are provided at all stairs at 34 in.	Yes
		Riser height (Min 4 in, Max 7 in) Consistency of dimension	1009.3	1011.5.4	The difference in riser heights exceeds 3/8 in. at various flights of the stairs.	No
	15.7	Ramps				
		Max slope – 1:12	1010.3		No ramps present.	
		Ramps with rise greater than 6 in shall have handrails on both sides.	1010.8		No ramps present.	
	15.8	Handrails and guards				
		Intermediate handrails to be provided so that all parts of egress capacity on stairs and ramps area within 30 in of a handrail.	1012.8	1014.9	Provide a maximum 60" between handrails at stairs. Main access entry stair has side rails only and is wider than 60 in.	No
		Guards to be 42 in. high min	1013.2		Areas requiring guardrails have rails that are high enough.	Yes
		Not allow a 4 in. diameter sphere to pass.	1013.3		At side yard walkway area, guardrail is provided with larger than 4" openings, but the guardrail is not required. Other required guardrails (at atrium and exit stairs) comply.	Yes
	15.9	Exit Signs				
		Not required in rooms or areas requiring only one exit.	1011.1	1013.1 Ex.1	Not provided in private office spaces, or small conference rooms.	Yes
		Required at exit and exit access doors and other areas so that no place in a corridor is more than 100 ft from an exit sign.	1011.1	1013.1	Some basement level open office areas have no visual access to exit signs, and do not directly view exits from the space.	No
		Exit sign may be either internally or externally illuminated.	1011.2	1023.9.1	Exit signs are externally powered.	Yes
		Illumination required to be on emergency power with 90 min duration	1011.5		Emergency generator is provided.	Yes

	Subject		2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
15	**Means of Egress**					
	15.10	Exit Access				
		Egress shall not pass through adjoining rooms except where such rooms are accessory to the area served, are not high-hazard, and provide a discernible path to an exit.	1014.2	1016.2	Refer to attached diagrams.	Yes
		When two or more exits are required, they shall be separated by one third the diagonal dimension of the space	1015.2.1 Ex.2	1007.1.1 Ex.2	Refer to attached diagrams.	Yes
	15.11	Approximate Travel Distance				
		Max. allowable travel distance from any location to an exit in an occupancy A3 is 250 ft when fully-sprinkled. Existing maximum travel distance is 150 ft.		Table 1017.2	Refer to attached diagrams.	Yes
	15.12	Corridors	Table 1018.1	Table 1020.1	No-rated corridors are required by code because the building is fully-sprinkeled.	Yes
	15.13	Minimum number of exits per story				
		For an occupancy load between 1 to 500 – 2 exits are required	1021	Table 1006.3.1	Three exits are provided in the basement. The first exit leads people outside and the second exit is an enclosed stairway that leads people to the first floor. The third is in an open stairway between the two floor. Five exits are provided in the first floor leading to outside.	Yes
	15.14	Vertical Exit Enclosures				
		Required rating – 1-hr	1022.1	713.4	It appears that the walls can meet a 1-hour rating, further observation is required to confirm this.	Yes
	15.15	Exit Discharge				
		A max of 50% of exit capacity is permitted to egress through areas in the level of discharge.	1027.1 Ex	1028.1 Ex.1 to 4	Code changed from CBC2010 to CBC 2016. The exit discharge meets all four exceptions.	Yes

		Subject	2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
16	**Roof Assembly and Rooftop Structures**					
	16.1	Roofing Classifications – Class A is required per City of Cupertino Ordinances	Table 1505.1		Most likely roof systems meet Class A. Research of the current roof system is required to determine if the roof mateial class is A. *FIR = Further Investigation Required	FIR
17	**Required Plumbing Fixtures**					
	17.1	Water Closets				
		Number of Water Closets Required: Male = 3 Female = 6 Number of Existing Water Closets: Male = 3 Female = 5		2016 California Plumbing Code (CPC) Table 422.1	Existing number of water closets does not meet current code requirements. Additional water closets need to be added to the building. One option can be to renovate existing bathrooms and use the existing shower and locker spaces for more toilets. Further studies of bathroom layouts are needed.	No
	17.2	Urinals				
		Number of Urinals Required Male = 2 Number of Existing Urinals Male = 2		2016 California Plumbing Code (CPC) Table 422.1	Existing number of urinals meet current code requirements.	Yes
	17.3	Lavatories				
		Number of Lavatories Required: Male = 3 Female = 3 Number of Existing Lavatories: Male = 3 Female = 3		2016 California Plumbing Code (CPC) Table 422.1	Existing number of lavatories meet current code requirements.	Yes
	17.4	Drinking Fountains				
		Number of Drinking Fountains Required: 3 Number of (E) Drinking Fountains: 3		2016 California Plumbing Code (CPC) Table 422.1	Drinking fountains meet code requirements.	Yes

	Subject		2010 CBC Reference	2016 CBC Reference	Notes by The KPA Group	Meets Code
17	**Required Plumbing Fixtures**					
	17.5	Bathtubs or Showers				
		Not Required		2016 California Plumbing Code (CPC) Table 422.1	Showers are not required in the building. Space can be utilized to serve other fixture deficiencies if needed. Refer to previous comments for design options.	Yes
	17.6	Service Sink or Laundry Tray				
		1 Required		2016 California Plumbing Code (CPC) Table 422.1	Service sink is needed in the building.	No

Occupancy Diagram



First Floor

Total Occupancy Load: 165

Basement

Total Occupancy Load: 82

Legend

- Occupancy A - Office
- Occupancy A - Open Office
- Occupancy B - Support
- Occupancy C - EOC
- x Room Number
- (x) Occupancy Load

The following document was provided by the City of Cupertino. This file was an analysis report from 2012, prepared by Perkins+Will (architect), AKH Structural Engineers Inc (structure) and PAE Consulting Engineers, Inc (MEP and fire protection).

Cupertino City Hall
Essential Services Facility Analysis

Final Report, Revision 1
March 27, 2012

Table of Contents

1.0 Project Participants

Client:
City of Cupertino
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Mike Lucas	Project Principal
Marco Alves	Mechanical Project Engineer
Hooshang Pakzadan	Electrical Project Engineer

2.0 Executive Summary

This scope of this project is an analysis of the Cupertino City Hall building and its compliance with current codes related to Essential Services Facility requirements. The objective of this study is to identify both deficiencies and potential improvements to the building necessary to achieve essential facility status by current codes.

Four alternative approaches were identified by the City of Cupertino representatives and the design team for the renovation of the existing City Hall facility. These approaches, described below, differ in their scope and anticipated construction cost. More detail for each item can be found in the body of the report.

Alt #1 No Upgrade: This alternate proposes no modifications to the existing City Hall building and a relocation of the existing Emergency Operations Center (EOC) to another facility.

Alt #2 Minimum Seismic Upgrade: This alternate proposes modifications to the building structure only to bring the facility to a code compliant Essential Services Facility status. No proposed plan changes are proposed in this alternate in order to maintain the ability to "grandfather in" the existing EOC in its current configuration. Only structural items triggered by I-factor improvements and maintenance are intended to be modified. Accessibility upgrade improvements may be triggered in this alternate.

Alt #3 Moderate Upgrade: This alternate proposes that all Alternate #2 items as well as additional plan modifications to address life safety code updates be implemented. Accessibility upgrade improvements would be triggered in this alternate.

Alt #4 Replacement – This alternate proposes a new City Hall building that aligns with ideas being proposed in the Civic Center Master Plan Study currently in process by Perkins + Will. This new facility would meet all current codes, incorporate sustainable features, and include Essential Services Facility requirements while at the same time address the specific needs and desires of the building occupants.

Following the completion of this report, the City of Cupertino and the design team will meet with a cost estimator designated by the city to identify order of magnitude costs for each alternative. After this process has been completed and an alternative is selected, the city may authorize the design team to proceed with the design and documentation of the selected alternative.

3.0 Structural Analysis (by AKH)

3.1 Scope

The scope of this section includes recommendations for mitigating structural deficiencies discovered in our assessment report dated November 11, 2011. The report has indicated that the heavy roof tile is a major factor in the deficiencies of the structure. The following recommendations are based on the assumption that the heavy tile roofing will be replaced by a lighter roofing material, and possibly with solar panels over some of the sloped roof areas.

3.2 Applicable Codes

The structure was recently assessed using seismic forces required in the 1985 Uniform Building Code (UBC), as this was the Code to which the 1986 alterations were designed. Recommendations within this report are based on seismic forces as dictated by the current 2010 California Building Code (CBC).

3.3 Deficiencies Identified

- Roof Diaphragm Shear Capacity
- Roof Diaphragm Collector Splice Capacity
- Anchor Bolt Connections at top of Shear Walls
- Upper Concrete Shear Wall Flexural Capacity
- Upper Concrete Shear Wall Boundary Members
- Upper Concrete Shear Wall Second Layer of Reinforcing
- Concrete Column Reinforcement for Confinement
- Equipment Anchorage Capacities Unknown

3.4 General Recommendations

This structure consists of concrete shear walls with heavy clay roof tiles on the sloped roof areas and heavy gravel ballast in the central area bounded by the upper mansard/screen wall. The roof tiles represent a significant portion of the building's mass at the upper level. The design seismic forces on a structure are based directly on a fraction or percentage of the total mass (weight) of the building. Thus, the roof tiles represent a significant amount of the seismic forces that the building's lateral force-resisting systems must resist. Our recommendations, therefore, include the replacement of the heavy tile roofing with a lighter material. This would also allow for the opportunity to install photovoltaic (PV) solar panels on the roof surface. As the weight of typical PV panels is small relative to the weight of the existing clay roof tiles, future improvements could include the addition of these PV panels while still reducing the building's mass and resulting seismic design forces.

Also, the upper story of this structure relies on two relatively narrow concrete shear walls on each of the four sides of the building. These shear walls comprise the building's entire lateral force resistance at the upper level, as the structure does not have any interior walls or structural frames that resist lateral forces. While the shear walls occur on each of the building's four sides, the walls are relatively narrow compared to their height, resulting in high in-plane shear stresses when resisting the seismic design forces, as well as relatively high tension and compression forces at the ends of the walls. Finally, the use of only two primary force-resisting elements on each side of the structure provides only minimal redundancy. Overall, the smaller number and length of walls result in a structural configuration that has historically performed less than optimally in resisting lateral, seismic forces in moderate and major earthquakes. Therefore we recommend that additional shear walls be added on each side of the structure. The included key plan of the building indicates where concrete walls can be added to the building, utilizing portions of existing solid exterior wall. These proposed locations would affect the building's current aesthetics and function to only a limited degree, if at all. See Fig. 3.A.

In general, if the clay roof tiles are replaced with lighter roofing materials (even including PV panels), the building's seismic mass would be reduced substantially, and the magnitude of most of the structure's noted deficiencies are reduced to levels that are more readily addressed.

3.5 Specific Recommendations

In addition to the general recommendations above, following are our specific recommendations for each of the deficiencies noted in the Section 3.3 above:

3.5.1 Roof Diaphragm Shear Capacity

The existing roof diaphragm is comprised of plywood sheathing with specific nailing along its panel edges to common framing members. Its shear capacity is affected by the type and thickness of plywood used, and the size and spacing of nailing used. The existing roof diaphragm shear capacity is exceeded even if the existing roof tile were to be removed and replaced with a lighter roofing material. The roof diaphragm forces would be reduced significantly with the replacement of the heavy clay roof tiles, although the calculated diaphragm shears would still exceed the diaphragm near the building's perimeter, which is where the diaphragm shear forces are highest. The plywood diaphragm can be strengthened as needed with added panel edge nailing near the perimeter of the building. This added nailing would be installed while the roofing is being replaced. See Figures 3.B and 3.G.

3.5.2 Roof Diaphragm Collector Splice Capacity

The existing roof diaphragm collectors consist of steel roof beams around the perimeter of the structure, and are aligned parallel to and above the upper-level concrete shear walls. These elements collect the seismic forces within the roof diaphragm and deliver the forces to the shear walls. Where splices occur in the lines of steel beams at approximately ten (10) locations, the connectors are currently not adequate to transfer the required seismic collector forces. Our recommendation to address this deficiency would be to provide welding around the splice plates to the beams at the splice connections. See Fig. 3.F.

3.5.3 Anchor Bolt Connections at top of Shear Walls

The collector beams mentioned in the previous section are connected to the top of the concrete shear walls with anchor bolts embedded in the walls and extending through the steel beam flange. This is the means through which the seismic forces are transferred from the roof to the shear walls. The current anchor bolts are insufficient to transfer the prescribed forces to the shear walls, even with added shear walls. Our recommendation is to provide adequate anchor bolts to any new walls and provide additional anchor bolts through the existing beams, between the existing anchor bolts, to strengthen the shear-transfer connections sufficiently. See Fig. 3.F.

3.5.4 Concrete Shear Wall In-Plane Flexural Capacity

In-plane flexure results from the shear walls bending when resisting seismic loads at their tops, tending to rotate and bend the wall over, causing tension and compression at wall ends. With the addition of upper-level new shear walls as recommended above, this flexural deficiency likely would no longer exist in the existing walls, as the forces resisted by the existing walls would be reduced, as well as the induced flexural forces. The added shear walls would be designed to have sufficient reinforcing to resist bending in the plane of the wall.

3.5.5 Concrete Shear Wall Boundary Members

Boundary members are required where the in-plane flexural forces generate high compressive forces at the wall ends. These compressive forces, when at a certain level, must be resisted by stronger column-type elements, containing internal confinement of the vertical wall reinforcing near the wall ends. The existing walls would require added boundary confinement to resist current Code-level forces. With the removal of the heavy roof tile and gravel, and depending on the lengths and locations of added shear walls as noted above, the compressive flexural forces would be reduced to a level where only the current Code's prescriptive requirements would be applicable. This could be accomplished in one of two possible means. First, a short length of reinforced wall could be added to the existing, which would move the highest compressive forces away from the existing bars, and would contain new bars and confinement complying with Code requirements. Second, if the wall length cannot be increased, a column element that is wider than the wall could be introduced, containing the required confining reinforcement.

3.5.6 Concrete Shear Wall Second Layer of Reinforcing

When calculated in-plane shear stresses within shear walls exceed a certain threshold, those walls must have two layers of internal reinforcing. The shear walls currently have one layer of reinforcing, comprised of vertical and horizontal rebar. With the removal of the heavy roof tile and addition of new perimeter shear walls as noted above, the shear stresses within the walls will likely be reduced to levels such that the second layer is not required.

3.5.7 Concrete Column Reinforcement for Confinement

The existing concrete columns throughout the structure, at both levels, contain longitudinal reinforcement running vertically and transverse, confining tie reinforcement around the longitudinal bars. The ties are of a specific size and occur at a specific spacing. In extreme cases, such as in moderate and major earthquakes, the lateral drift of the structure, combined with the axial forces from the supported structure, can induce extremely high compressive forces in the longitudinal (vertical) column bars. If not confined adequately by ties of sufficient size, at spacing that is close enough, the vertical bars can buckle outward, causing damage to the column, loss of support and possible collapse. Regardless of the calculated forces in the existing columns, the existing column ties do not conform to the current Building Code's prescriptive requirements for minimum confinement. Thus, supplemental confinement needs to be added for conformance to the current Code. This added confinement may be required only near the ends of some columns, or for the full height of the columns, depending on the calculated column loads. Where additional confinement is required, it is recommended that the columns be wrapped with designed layers of carbon fiber and resin. The total build-up of carbon fiber layers is relatively thin, and would not adversely affect the spaces where the columns occur.

As indicated in these descriptions, and in general, the noted deficiencies can be addressed and resolved only with a sufficient reduction of the building's mass through the removal of the heavy clay tile roofing, and with the addition of some lengths of new upper-level concrete shear walls. The recommended alterations combine to reduce the seismic forces acting on the structure, increase the strength and capacities of the load-resisting elements, including the shear walls and collector members. The following key building plan indicates the recommended locations for the proposed added shear walls, which would likely affect the building's aesthetics and functionality to only a minimal degree.

3.5.8 Equipment Anchorage Capacities Unknown

The capacity of the anchorage of the equipment throughout the building is unknown and warrants a survey of existing on-site conditions, as well as any drawings available that address the methods of anchorage and lateral bracing. The current Building Code excludes some equipment below certain weight limits from requiring anchorage, if the Component Importance Factor (Ip) for determining the anchorage design forces is no higher than 1.0. However, since the entire subject structure is considered an Essential Facility, housing the EOC, the Importance Factor for the overall building's seismic design, as well as the seismic Component Importance factor, Ip, is 1.50. Thus, the seismic anchorage of all

significant equipment anchorage is governed by the Code. Equipment that should be considered, in particular, includes the following:

- Emergency Generator, including isolators
- Emergency Generator flexible connections for conduit, fuel and coolant piping
- Rooftop HVAC Equipment
- Elevator Equipment
- Electrical Transformers, Panels, Switchgear, Cabinets, etc.
- Suspended Light Fixtures
- Ductwork and Piping Supports and Bracing
- Electrical Conduits, Trapezes, Banks and Trays
- Fire Sprinkler Piping

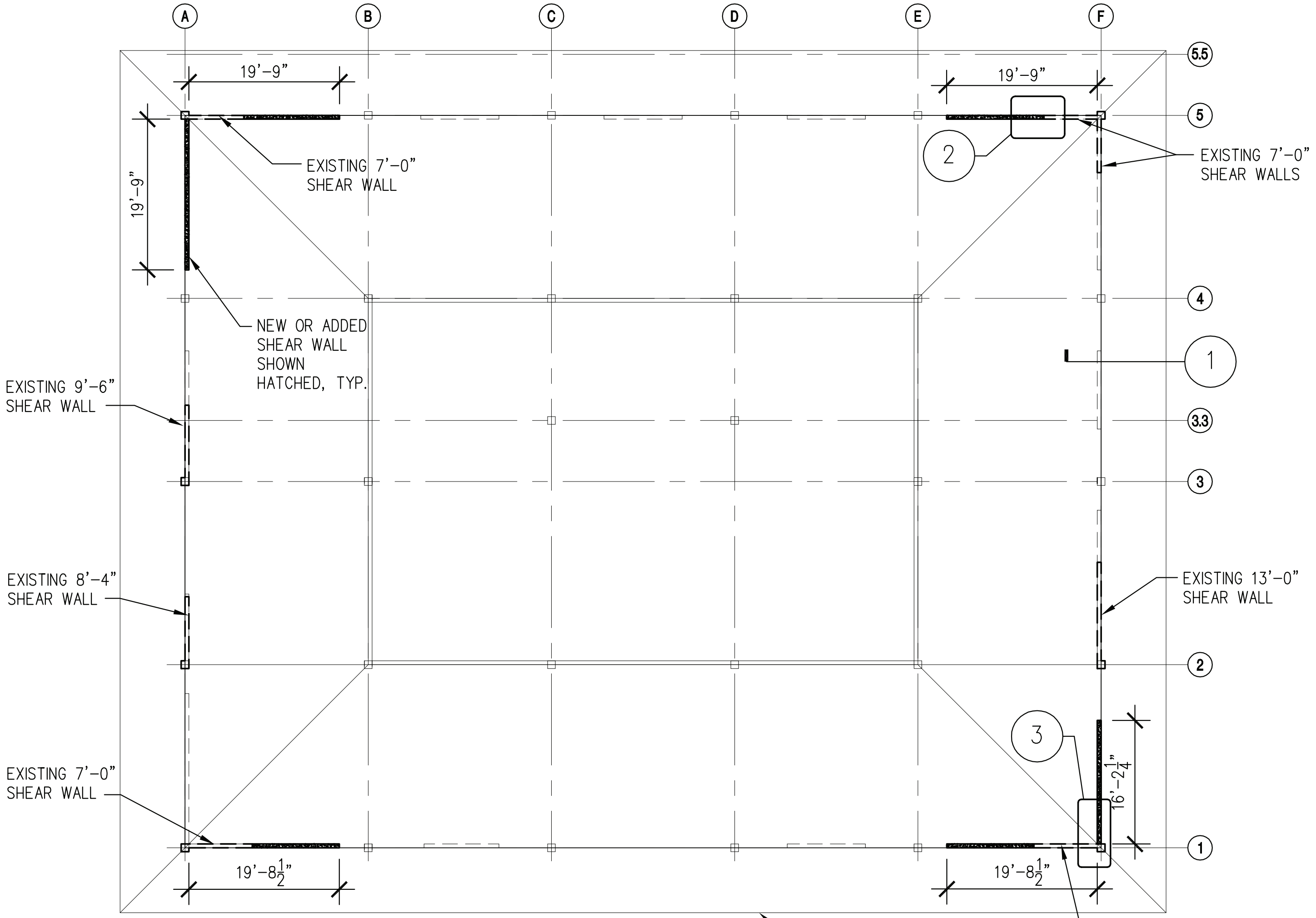

Figure 3.A: KEY STRUCTURAL BUILDING PLAN
(MAIN FLOOR WALLS SHOWN DASHED)

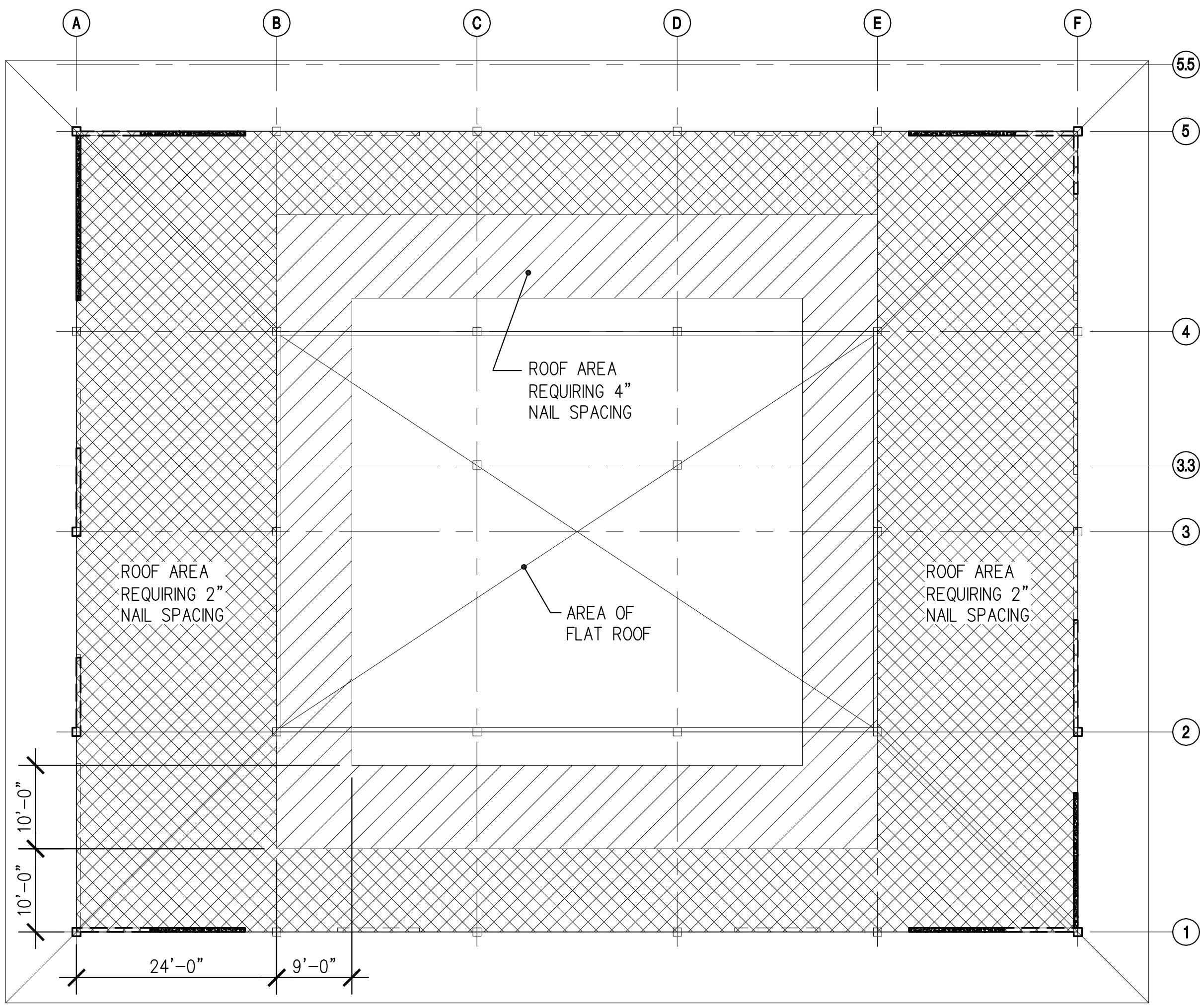

Figure 3.B: KEY ROOF PLAN
(MAIN FLOOR WALLS SHOWN DASHED)

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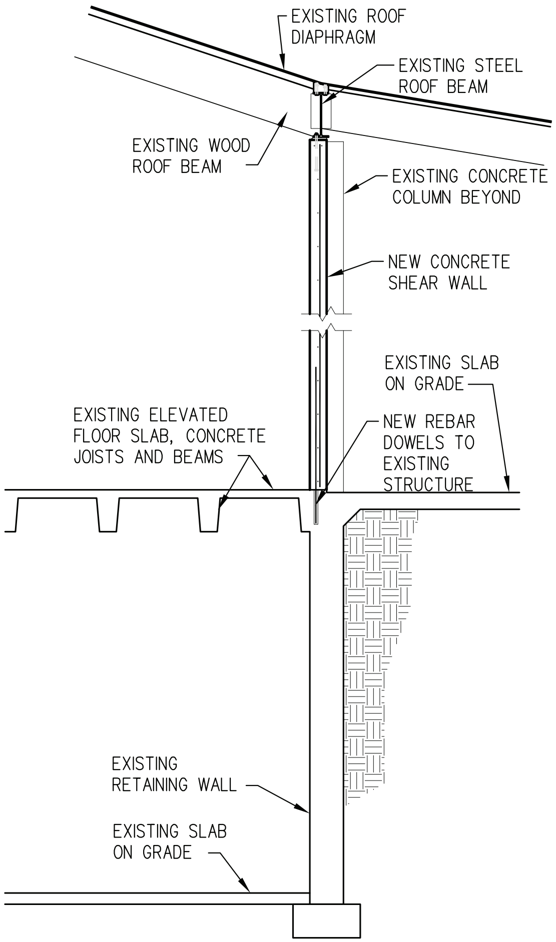

Figure 3.C: SECTION AT NEW SHEAR WALL

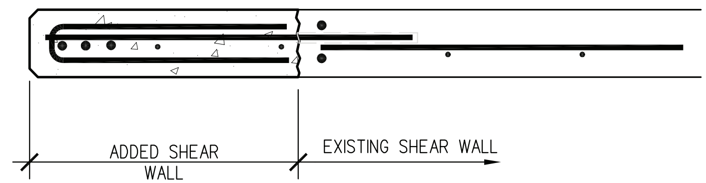

Figure 3.D: NEW SHEAR WALL AT EXIST. WALL

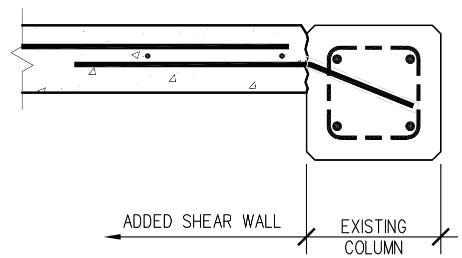

Figure 3.E: NEW SHEAR WALL AT EXIST. COL.

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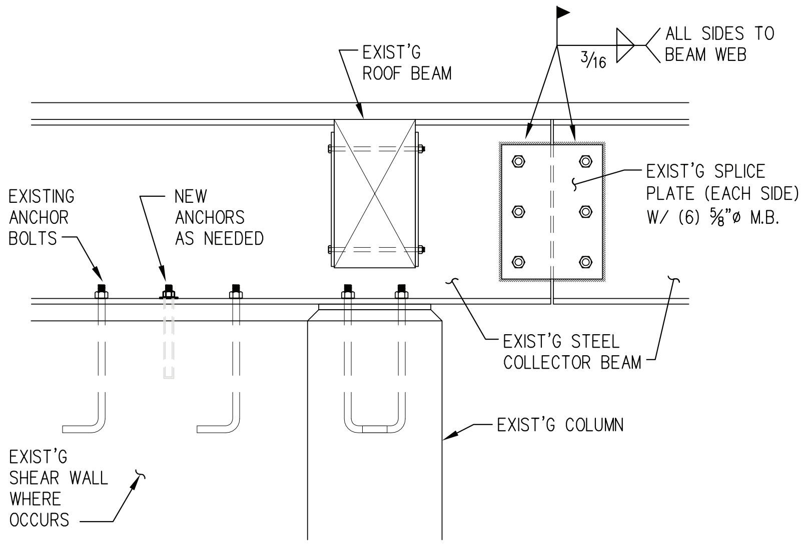

Figure 3.F: ELEVATION: EXISTING STEEL BEAM AT COLUMN AND SHEAR WALL

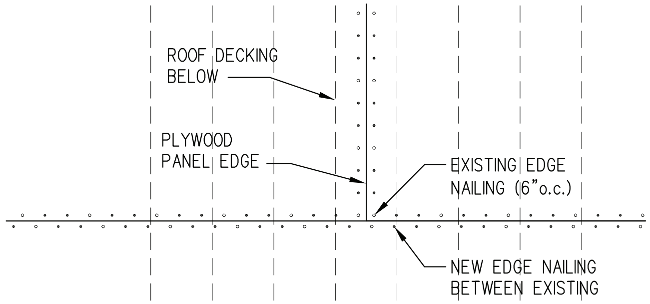

Figure 3.G: PLAN OF PLYWOOD PANEL EDGE NAILING

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4.0 Architectural Analysis

4.1 Scope

The existing Cupertino City Hall building is a two-story structure containing city administrative and building department services as well as the City of Cupertino's Emergency Operations Center (EOC.) The original building was built completed in 1965 and later renovated in 1986.

This study is based on record documents listed below and received electronically from the city as well as a facility site walk on Feb 14, 2012.

- 1965 Drawings for Original Construction
- 1986 Drawings for Renovation (except single line Electrical plans)
- Current Exiting Diagram included the latest floor layout modifications

The architectural analysis primarily focuses on fire and life safety issues and includes a detailed code compliancy review of the existing City Hall building as an Essential Service Facility. The recommendations follow the analysis and include four alternatives outlined by city representatives and the design team.

The current code, the 2010 California Building Code (CBC), and the 1985 Uniform Building Code used for the renovation exhibit significant differences in all chapters. The first step of this analysis was to review the existing building against the 2010 CBC. Exhibit 4A provides the analysis in detail. Exhibits 4C and 4D show occupancy load calculations, exit occupancy calculations, and required rated wall locations.

The required scope of accessibility modifications for the existing building is also summarized to define the extent of potential renovation work. Exhibit 4B lists scope requirements from the 2010 CBC Chapter 11B.

4.2 Applicable Codes

The 2010 CBC was used to review code compliancy. The 2010 California Green Building Code (Cal Green) was not used for the analysis of the existing building. Currently, the City of Cupertino does not enforce the Cal Green for the remodel of existing buildings.
The requirements of 2010 ADA Standards for Accessible Design is applicable for local government facilities and was also used to review for compliancy.

4.3 Key Fire and Life Safety Issues

The key issues below are extracted from Exhibit 4A - Code Analysis Worksheet.

- **Occupancy Classification**
  The existing Council Room is approximately 1,300 sf (over 10% of the total floor area of the first floor) with an Occupancy Load of 86. The room cannot be considered an incidental accessory occupancy because it is too large. It needs to be considered an A3 Occupancy, a separate occupancy from rest of the building, which is a B Occupancy.

- **Type of Construction**
  The type of construction is Type VB with an automatic sprinkler system throughout.

- **Fire Resistive Separations**

  Interior Walls:
  A 1-hour Fire Barrier separation is required between A and B occupancies. The existing wall is shown as a 1-hour partition in the 1986 drawings. The wall construction above the ceiling needs to be further investigated. The doors in the 1-hour Fire Barrier need to have a 45-minute fire resistance rating. The existing two doors are labeled with 20-minute ratings. The label of the third door was covered by finish material and not legible. It will need to be replaced if it cannot be confirmed as compliant. See section 4.5.1 of the 2010 CBC.

  Although the 1-hour separation requirement of an incidental use area is exempted because the existing building is equipped with a sprinkler system, the Mechanical Room and Storage Rooms (over 100 sf) require smoke partitions. The 1986 drawings indicate the existing Mechanical Room is enclosed by a 1-hour partition. See section 4.5.2 of the 2010 CBC.

  Elevator Shaft Enclosure:
  The existing elevator shaft may be deficient. The drawing A2.1 (1986 Renovation) indicates "Carry shaft wall to underside of lobby ceiling". Fire Barriers need to extend to the underside of the roof sheathing per 707.5 or enclosed at the top with the same fire resistance rating per 708.12. See section 4.5.3 of the 2010 CBC.

  Exit Stair Enclosure:
  The exit stair enclosure wall needs to be a 1-hour Fire Barrier with a 1-hour rated opening. The existing door on the first floor is labeled as 60-minute. The rating of the door on the basement was not legible and will need to be replaced if it cannot be confirmed as complaint. See section 4.5.4 of the 2010CBC.

- **Corridors**
  The building's corridors are not required to be separated by fire or smoke partitions because the existing building is A and B Occupancies and equipped with a sprinkler system. The existing corridors open to the public area are rated per the 1986 drawings. The existing openings between the west corridor and the office area are allowed per the current code.

- **Interior Finishes**

  Wall and Ceiling:
  Corridors serving the egress of the EOC, West Corridor, Lobby, and South Corridor require Class B finishes on the walls and ceiling. The existing finish materials need to be further examined to confirm that they meet the ASTM E-84 Class B frame spread rating and the ASTM C 635 or C636 for suspended acoustical ceiling. See section 4.5.6 of the 2010 CBC.

  Floor:
  A Class I or II interior floor finish is required in all exit routes. The existing finishes need to be further reviewed and replaced if they cannot be confirmed as compliant. See section 4.5.6 of the 2010 CBC.

- **Means of Egress**

  Occupant Load:
  The Occupant Load of the existing building is calculated based upon the area under consideration divided by an occupant load factor per section 1004.1.1 of the 2010 CBC. See Exhibit 4A.

  Egress Width:
  All existing doors and corridors currently provide more than the required egress width. Exiting occupancies at the exit discharge are:

Basement Terrace	98
Main entrance	57 (113 / 2 exits)
South Corridor Door	35
North Door	29

  Accessible Means of Egress:
  Accessible means of egress are not required in alterations to existing buildings per section 1007.1 Exception 1 of the 2010 CBC.

  Panic Hardware:
  Mechanical Room and Transformer Room doors need panic hardware or fire exit hardware per section 1008.1.10 of the 2010 CBC. The existing doors do not have the required hardware.

  Vertical Exit Enclosures–Lobby Open Stairs to Basement:
  The analysis of the exiting occupancy revealed that the basement floor egress is not code compliant without using the open stairs as means of egress. The 2010 CBC allows for vertical openings in a stairway only if it is not part of means of egress per 708.2 Exceptions; therefore, in order to meet the requirements of the code the stair will require the installation of draft curtains and closely spaced sprinklers. These upgrades based on the interpretation above are believed to be more economical than

converting the open stairway to an enclosed exit stair. See section 3.5.7 of the 2010 CBC.

- **Roof Assembly and Rooftop Structure**

  A roof assembly is required to meet Class A fire test exposure in accordance with the city ordinances. The existing roof equipment shows an incomplete attachment mechanism to the roof deck. See section 3.5.8 of the 2010 CBC.

4.4 Other Issues

4.4.1 Accessibility

The extent of the specific accessibility upgrades will require further study as well as design solutions after a solution is selected. Exhibit 4B describes accessibility requirements for existing buildings.

The 2010 CBC requires that accessibility upgrades apply only to the area of specific alteration. The 2010 ADA Standards (Chapter 2, 202) state "each altered element or space shall comply with the applicable requirements".

The 2010 CBC also outlines construction cost thresholds for specific levels of accessibility upgrades. For a project where the construction cost does not exceed $50,000, it requires accessibility compliance only in the area of the actual work and not in supporting areas. For a project where the construction cost does not exceed $128,410.86, it allows accessibility compliance to be limited to 20% of the cost of the project. Priority must be given to the accessible elements in the following order.

- sanitary facilities
- drinking fountains
- signs
- public telephone
- additional accessible elements such as parking, storage, and alarms

For a project where the construction cost exceeds $128,410.86, the facility must be made fully accessible.

4.4.2 OSHA

Access to all areas for building maintenance will need to meet Cal-OSHA standards. The metal ladder to the roof requires a safety upgrade.

4.4.3 Sustainability

A comprehensive sustainable strategy and specific sustainable solutions are not identified in this report; however, as the project moves to the next phase we would recommend incorporating a sustainable approach into the solution selected.

4.4.4 Architectural & Planning

Several architectural and planning issues were identified by the building representatives and design team during the Feb 14, 2012 site walk. These items were captured in the Meeting Minutes, item 2012-02-14.07, and should be addressed if Alternate #3 or Alternate#4 is selected for implementation.

4.5 Recommendations

Four alternative approaches were identified by the City of Cupertino representatives and the design team for the renovation of the existing City Hall facility. These approaches, described below, differ in their scope and anticipated construction cost.

Alt #1 No Upgrade: This alternate proposes no modifications to the existing City Hall building and a relocation of the existing EOC to another facility.

Alt #2 Minimum Seismic Upgrade: This alternate proposes modifications to the building structure only to bring the facility to a code compliant Essential Service Facility status. No proposed plan changes are proposed in this alternate in order to maintain the ability to "grandfather in" the existing EOC in its current configuration. Only structural items triggered by I-factor improvements and maintenance are intended to be modified. Accessibility upgrade improvements may be triggered in this alternate. The modifications include:

- Replacement of roof tile – as maintenance
- Possible adjustment of roof profile and equipment screen
- Connection of collector beam and concrete shear wall
- Additional concrete wall to the main level, if required. (The modification should not affect floor plan and egress)
- Ducts and equipment seismic support
- Accessibility upgrade for 20% of construction cost if required

Alt #3 Moderate Upgrade: This alternate proposes that all Alternate #2 items as well as additional plan modifications to address life safety code updates be implemented. Accessibility upgrade improvements would be triggered in this alternate. The modifications include:

- All Alt #2 items
- Fire and Life Safety upgrade to meet 2010 CBC
- MEP upgrades to meet operation requirements as Essential Services Facilities including replacement of HVAC equipment/control, water heater/plumbing pipe, adjustments of sprinkler system, and upgrade of the electrical system after testing and verifications.
- Minimum energy efficiency to meet performance of the existing building
- Accessibility upgrade

Alt #4 Replacement – This alternate proposes a new City Hall building that aligns with ideas being proposed in the Civic Center Master Plan Study currently in process with Perkins + Will. This new facility would meet all current codes, incorporate sustainable features, and include Essential Service Facility requirements while at the same time address the specific needs and desires of the building occupants.

These recommendations are based on the findings from the available drawings and observations of the accessible areas during the site walk. As highlighted above, some areas of the existing building have unknown conditions and will require further investigation after an alternate is selected:

- penetrations thru partitions
- above-ceiling conditions
- actual construction of the interior partitions
- storage rooms created during the recent renovation around the EOC
- renovated areas in locations where the record drawings were not available

Specific recommendations for the correction of items identified in the code analysis are outlined below. If Alternative #3 or Alternative #4 described above is chosen, all architectural code deficiencies must be integrated into the solution.

4.5.1 1-hour Fire Barrier at Council Room

The existing doors to the Council room need to be replaced with at least 45-minute fire resistance rated doors. The partition may need to be repaired or re-built to meet 1-hour Fire Barrier requirements. The existing rated partition enclosing Council room should be further field investigated.

4.5.2 Smoke Partitions to Mechanical Room and Storage Room

The existing doors to the Mechanical Room and Transformer Room need to be replaced with panic hardware. The existing wall and doors enclosing the Mechanical Room need to be rebuilt or repaired to meet smoke partition requirements.

Mechanical Room work space clearances and clear path of travel require further investigation near the 1600 Amp electrical panel. The room requires either 2 exits with panic hardware or 1 exit door with panic hardware and a clear unobstructed path from panel to exit door, or a single exit door with panic hardware and double the required working space around the panel.

Storage Rooms (areas exceeding 100sf) need to be enclosed by smoke partitions. The Storage Rooms north of Council Room that were recent additions/modifications exceed 100sf. These walls and doors need to be rebuilt or repaired to meet smoke partition requirements.

4.5.3 Elevator Shaft Enclosure

The construction of the existing elevator shaft enclosure needs further field investigation to verify if it meets the 1-hour Fire Barrier requirements. The shaft enclosure may either need to extend to the roof sheathing or be enclosed at the top of the shaft with 1-hour fire resistance rated assembly.

4.5.4 60-Minute Door to the Exit Stair at Basement

The exit access door to the existing exit stair should be confirmed as a 60 minute door or replaced with a 60 minute door. The construction of the existing exit stair shaft enclosure needs further field investigation to verify if it meets the 1 hour Fire Barrier requirements.

4.5.5 Interior Finishes

The finishes of West Corridor, Lobby, and South Corridor need further field investigation to confirm if they meet the current code classifications. The finishes may need to be replaced to meet the requirements.

4.5.6 Lobby Open Stairs to Basement

The existing open stairs from Lobby to the basement should be designated as non-exit stairs. In addition, the draft curtains and closely-spaced sprinklers per NFPA 13 need to be installed. The exit sign should be rearranged accordingly.

4.5.7 Roof Assembly and Rooftop Equipment

The attachment of the roof equipment to the roof deck must be secured following the I factor requirements for the Essential Services Facilities. Reroofing assembly is required to meet Class C roofing.

4.5.8 Replacement of Roof Tile (This item is for Alt #2)

As described in the Structural Section 3.4 General Recommendations, the heavy tile roofing should be replaced with a lighter material such as standing seam metal roofing system. A system can be selected to match the appearance of the adjoining buildings in the Civic Center. As the project proceeds an option to integrate photovoltaic panels or film at the roof should be investigated.

Exhibit 4A - Code Analysis Worksheet

This exhibit is prepared to review the code compliancy of the existing City Hall under 2010 California Building Code.

	Subject	CBC Reference	Notes
1.	**Building Description**		
	• 1 above grade story with 1 below grade basement	Table 503 See 7	OK
2.	**Building Height**		
	• Height to highest occupancy Story: 1.8 ft above finish grade (224.9 FG, 226.7 FF)		
	• Height to top of roof: 20'-11 ½" @ top of beam, 26' @ top of parapet	Table 503 See 7	OK
3.	**Building Separations**		
	• East: 174 ft		
	• West: 60+ ft (60 ft to PRW)		
	• North: 60+ ft (60 ft to PRW)		
	• South: 103 ft (to 1964 PL)		
	All exceeds 30' in Table 602 fire Separation distance	Table 602	OK
4.	**Occupancy**		
	<u>Building Area</u> / <u>Occupancy</u> First Floor: B (Except Concil room: A3, 1,300sf) Basement: B Note: EOC Room (former Council Room) will be separated Occupancy from the rest of the building because the area sqft of 1,300sf exceeds 10% of the building area of the floor (508.2.1). The occupant load of the EOC Room is 1,300/15 = 86. The two occupancies need to be separated by 1hr fire barrier (Table 508.4)	508.4	
5.	**Approximate Building Area**		
	Level 1: 11,520 sf <u>Basement: 11,520 sf</u> Total: 23,040 sf		
6.	**Type of construction**		
	Type V-B (fully sprinklered)		
7.	**Allowable Area and Height** – Type V-B (fully-sprinklered)		
	B occupancy — <u>Allowable / Built</u>; A-3 Occupancy — <u>Allowable / Built</u> Story (above grade): 2 / 1; 1 / 1 Height: 40ft / 26 ft; 40ft / 26 ft Floor Area / Story: 18,000sf / 11,520sf; 12,000sf / 1,300sf Per 508.4.2 11520/18000 + 1300/12000 = 0.748 < 1.00	Table 503 508.4.2	OK
8.	**Fire Resistive Requirements** – Type V (fully-sprinklered)		

	Subject	CBC Reference	Notes
	• Structural Frame: 0 hrs • Bearing Walls o Exterior: 0 hrs o Interior: 0 hrs • Non-bearing Walls o Exterior: 0 hrs o Interior: 0 hrs • Floors: 0 hrs 3" concrete floor • Roof: 0 hrs 6x6 beam, 2x6 T&G Deck, 5/16" Plywood	Table 601 & 602 603.1 & 717.5	OK
9.	**Fire Resistive Separations**		
	• 1-hr Fire Barrier separations between B and A1 occupancy	508.4	
	• Incidental Use Areas o Mech / Boiler Room (031 & 032) – o Storage over 100 sf (036, 038, New storage north of Council) 1-hr separation or provide automatic fire extinguishing system – OK w/ Fully sprinklered bldg Smoke Partition (711; Full ht solid walls w/self-closing solid drs) is still required	508.2 508.2.5.2	OK
10.	**Exterior Walls**		
	• Opening Allowed in exterior walls		
	• Max area of exterior wall openings allowed: No Limit Fire Separation distance is > 30'	Table 705.8	OK
	• Parapets: not required – exterior wall is not required to be rated	705.11	OK
11.	**Interior Walls**		
	• Fire Barriers – separating B & A3 occupancy around fmr. Council Room	707	
	o Extend from the top of the floor 0 ceiling assembly below to the underside of the floor or roof sheathing. o Openings are limited to 25 % of length of wall o Openings are not limited to 156sf if fully-sprinklered o Opening protection Wall Type — Opening Rating 1-hr shaft / exit enclosures — 1 hour 1-hr fire barrier — 45 min.	707.5 707.6 707.6 exc 1 Table 715	dr & glazing need upgrade to 45 min assembly
	• Shaft Enclosures – exit stairs, elevator hoist way	708	
	o Enclosures to have fire barrier with 1-hr fire resistance rating o Openings limits are not applicable for for exit enclosures o Opening protection – see above	708.4 707.6	Visually inaccessible, Need further investigation of shaft termination above ceiling
	• Corridors – Not req'd to be separated by fire or smoke partitions in A and B occupancy if fully sprinklered.	Table 1018.1	OK
	• Enclosed Elevator Lobby		

	Subject	CBC Reference	Notes
	o not required not mre than 3 stories in Group B	708.14.1	OK
	o not required for A where the building is fully-sprinklered	708.14.1 Ex 4	OK
12.	**Penetrations**		
	• Thru penetration fire stop systems protecting wall penetrations shall have an F rating equal to the rated wall	713.3.1.2	Visually inaccessible, Need further investigation
	• Thru penetration fire stop systems protecting rated horizontal assemblies shall have an F and a T rating of 1 hour or equal to the rated assembly	712.4.1.1.2	Visually inaccessible, Need further investigation
13.	Interior Finish	803.1	
	• Wall and ceiling finishes per ASTM E-84, Class A, B & C / NFPA 286		
	• Flame spread Req Area Served — Rating Exit Enclosures — B Corridors Serving A Occupancy — B Other rooms & corridors — C	Table 803.9	
	• Suspended acoustical ceilings per ASTM C 635 or C636	808.1.1.1	?
	• Class I or Class II interior floor finish req'd in all exit route	804.4.1	?
14.	**Automatic Sprinkler system** – per MEP analysis	903.2.1.3	OK
15	**Means of Egress**		
	• Occupant load Is established in Figure 1 based upon the area under consideration divided by an occupant load factor	Table 1004.1.1	OK
	• Egress width	1004	
	o Considered for floors individually	1004.4	OK
	o Stairways – factor .3 in o Other egress component – factor .2 in	1005.1	OK
	• Lighting	1006.2	Noted in Elect Section
	o 1 fc –at walking surfaces f exit access, exits, and exit discharge		
	o 10 fc – at walking surface of stairs during use		
	o Emergency power 90min min	1006.4	
	• Accessible means of egress	1007.1	
	o Accessible means of egress are not required in alterations to existing buildings	1007.1 Ex 1	OK
	• Doors		
	o Shall have a clear width of at least 32 in and no door leaf shall be greater than 48 in – all egress doors exceed required width	1008.1.1	OK
	o With limitations, egress doors may include:	1008.1.4	OK

	Subject	CBC Reference	Notes
	▪ Revolving doors ▪ Power-operated doors ▪ Access-controlled doors		
	o Panic hardware is required on exit doors from ▪ A occupancies ▪ Elect rooms rated over 1200 A – check with Electrical.	1008.1.10	OK
	• Stairways		
	o Min width is 44 in unless serving fewer than 50 people, except accessible egress stairs o Handrails may extend 4 ½" from stair wall into req'd clear width	1003.3.3 1012.7	OK
	o At accessible egress stairs, the stairs are req'd to have a min clear width between handrails of 48 in min width is 44 in unless serving fewer than 50 people, except accessible egress stairs	7.2.12.2.3	n/a per 1007.1 Ex. OK
	o Min headroom clearance is 80 in	1009.2	OK
	o Riser height ▪ Min 4 in, Max 7 in	1009.3	OK
	o Ramps (for exiting) o Max slope – 1:12 o Max cross slope – 1:48 o Max vert rise – 30 in o Ramps with rise greater than 6 in shall have handrails on both sides	1010.3 1010.4 1010.8	n/a OK
	• Handrails and guards		
	o Shall be provided on both sides of stairs and ramps with risers grater than 6 in	1009.10	Need further review
	o Intermediate handrails to be provided so that all parts of egress capacity on stairs and ramps area within 30 in of a handrail	1012.8	
	o Guards required on elevated surfaces with an adjacent droop more than 30 in	1013.1	
	o Guards to be 42 in high min	1013.2	
	o Not allow a 4 in diameter sphere to pass	1013.3	
	• Exit Signs		
	o Not required in rooms or areas requiring only one exit	1011.1	OK
	o Required at exit and exit access doors and other areas so that no place in a corridor is more than 100 ft from an exit sign	1011.1	OK
	o Exit sign may be either internally or externally illuminated	1011.2	OK
	o Illumination required to be on emergency power with 90 min duration	1011.5	OK
	• Exit Access		
	o Egress shall not pass through adjoining rooms except where such rooms are accessory to the area served, are not high-hazard, and provide a discernible path to an exit	1014.2	OK
	o When two or more exits are required, they shall be separated by one third the diagonal dimension of the space ▪ fmr Council – 2 exits provided ▪ Mech room – 2 exits provided	1015.1 1015.1 1015.3	OK
	• Travel Distance		
	o Max allowable travel distance from any location to an exit		
	A3: 250 ft (w/ fully-sprinklered)	Table	OK

	Subject	CBC Reference	Notes
	B: 300 ft (w/ fully-sprinklered)	1016.1	
	• Common path of travel distance		
	o The max allowable common path of travel distance from any location to a point where occupants have a choice between two separate exit paths is limited to 100 feet for Group B and S	1014.3	OK
	• Corridors in sprinkler protected B or S may be non-rated	Table 1018.1	OK
	o Corridor width to be OL x 0.2 but not less than 44" o 36" with a required occupant capacity of less than 50	1005, 1018.2 1018.2 Ex	OK
	o Dead ends may not exceed 50 feet in B		
	• Min number of exits		
	o OL 1-500 – 2 exits required	1021	OK
	• Vertical Exit Enclosures		
	o Required rating – 1-hr o A max of 50% of exit capacity is permitted to egress through areas in the level of discharge w/ three conditions check (1.2 floor rating of 3" conc) o Stairs to the building permit counter should not be used for egress, to be "communicating stair"	1022.1 1027.1 Ex	Adjust exit sign accordingly
	• Exterior Exit Stairs and Ramps		
	o Exterior exit stairways can be used in a means of egress o Must be open at one side o Not required to have separation per exceptions	1026.2 1026.3 1026.6 Ex.	OK OK OK
	• Exit Discharge		
	o A max of 50% of exit capacity is permitted to egress through areas in the level of discharge w/ three conditions check	1027.1 Ex	OK
16	Roof Assembly and Rooftop Structures		
	• Roofing Classifications – Class A is required per City of Cupertino Ordinances	Table 1505.1	Classification of (E) roof assembly is unknown.
	• Existing roof replacement – more than 50% of the total roof area is replaced within any one-year period, the entire roof covering of every new structure, and any roof covering applied in the alteration, repair, or replacement of the roof of every existing structure shall be a fire–retardant roof covering that is at least Class C	1505.1.3	To be Class A per City of Cupertino Ordinances

Exhibit 4B - Accessibility for Existing Buildings

This Exhibit is prepared to summarize the required accessibility upgrade for the existing buildings per 2010 CBC.

	Subject	CBC Reference	Notes
1.	**Accessibility for Existing Buildings**	1134B	
	• Provisions apply to renovation, structural repair, alteration and addition to existing buildings	1134B.1	
	• No decreased accessibility of existing buildings	1134B.2	
	• Requirements shall apply only to the area of specific alteration structural repair of addition o Primary entrance to the building o Primary path of travel to the specific area of alteration, structural repair or addition o Followings that serves the area of alteration, structural repair or addition ▪ Sanitary facilities ▪ Drinking fountains ▪ Signs ▪ Public telephone		
	Exceptions #1 • Total construction cost does not exceed $128,410.86 (Jan 2010) • Unreasonable hardship is where exceeds 20% of the cost of the project without these features (disproportionate cost) • Access shall be provided to the extent that it can be within 20% of the cost of project • Priority is to these elements that will provide the greatest access following order o An accessible entrance o An accessible route to the altered area o At least one accessible restroom for each sex o Accessible telephones o Accessible drinking fountains o When possible, additional accessible elements; parking storage and alarms • 3 years duration of accumulated cost when there are many small work • Alterations after Jan 1992 shall be considered in determining if the cost of providing a accessible path of total is disproportionate **Exceptions #2** • n/a - Re: privately funded project **Exceptions #3** • Accessibility improvement work itself is limited to the actual work of the project **Exceptions #4** • Work limited to o HVAC o Re-roofing o Electrical (not included switches and receptacles) o Cosmetic work	1134.2.1 Ex.	
	• Alternative uni-sex per floor will be permitted if technically infeasible	1134B.2.2	

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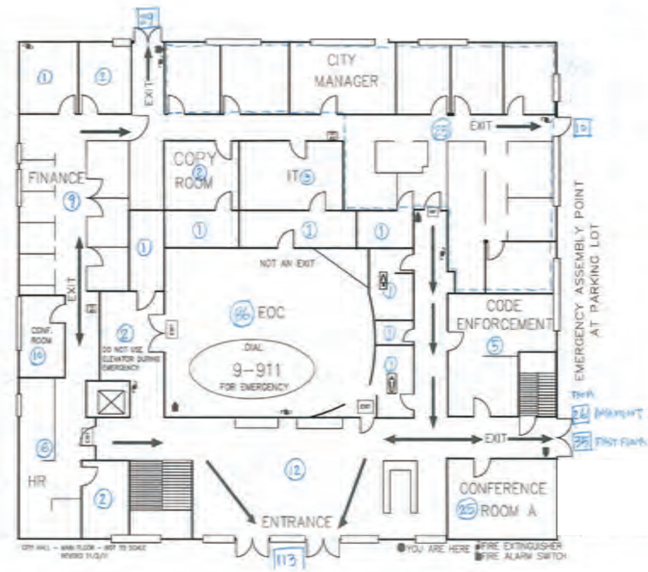

Exhibit 4C First Floor Occupancy Load and Exit Diagram

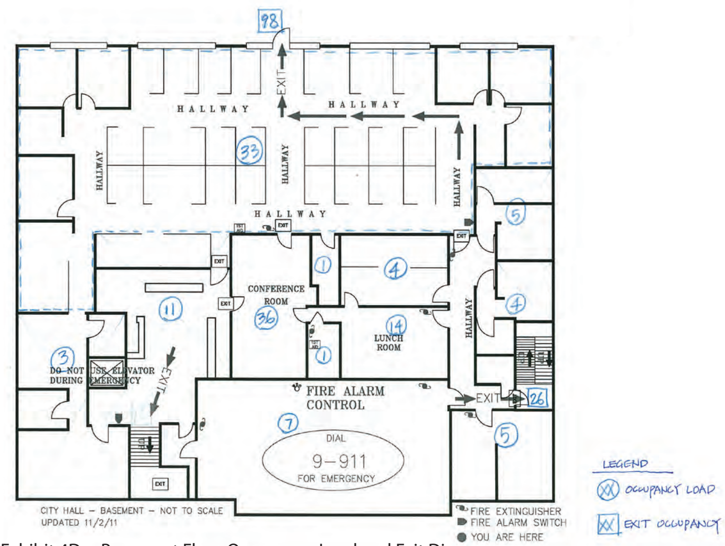

Exhibit 4D Basement Floor Occupancy Load and Exit Diagram

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5.0 Mechanical, Electrical, Plumbing, Fire Protection Analysis

5.1 Scope

The main goal of this report is to evaluate the MEP equipment and infrastructure serving the Cupertino City Hall and the EOC. The evaluation of the existing MEP systems is being performed according to the following overall facility improvement alternatives:

- Alt #1 No Upgrade - Relocation of EOC
- Alt #2 Min Seismic Upgrade – Duct, pipe, and equipment seismic support (per I factor change)
- Alt #3 Moderate Upgrade - Alt #2 items, Fire & Life Safety upgrade to meet 2010 CBC, MEP upgrade to meet operation requirements as Essential Services Facilities, Energy efficiency to meet performance of the existing building
- Alt #4 Replacement – New Building

5.2 Applicable Codes and Standards

Codes:

State of California Code of Regulations (CCR).

2010 California Building Code.

2010 California Electrical Code.

2010 California Mechanical Code.

2010 California Plumbing Code.

2010 California Fire Code.

2010 California Energy Code, Title 24 – 2008

2010 California Green Code, CALGreen

City of Cuppertino Municipal Code

Standards:

ASHRAE Standard 62.1-2010 – Ventilation

ASHRAE Standard 55-2010 – Thermal Comfort

ASHRAE Standard 90.1-2010: Energy Standard for Buildings except Low-Rise Residential Buildings

AMCA – Air Movement and Control Association International, Inc.

ANSI – American National Standards Institute.

ARI – Air Conditioning and Refrigeration Institute.

SMACNA – Fire and Smoke Damper Installation Guide.

SMACNA – Guidelines for Seismic Restraints of Mechanical Systems.

SMACNA – Standards for Duct Construction.

NEMA – National Electrical Manufacturer's Association.

NEMA - National Electrical Manufacturers Association.

NECA - National Electrical Contractors Association.

IEEE - Institute of Electrical and Electronic Engineers.

UL – Underwriters Laboratories.

NFPA - National Fire Protection Association.

NFPA 90A – Air Conditioning and Ventilating Systems.

NFPA 101 – Life Safety Code.

NFPA 13 – Standard for the Installation of Sprinkler Systems.

5.3 Mechanical HVAC Systems

5.3.1 Heating and Cooling Systems

The HVAC system for the Cupertino City Hall consists of a water-cooled chiller plant (70 Ton) with the cooling tower located on the roof and the chiller located on the lower level. A gas fired non-condensing boiler generates heating hot water. The boiler is from the 1965 original building construction and is well past its life time. Both of these systems provide chilled and heating hot water to the Air Handling Units (AHU's) located at the lower level that heat and cool the building through a VAV reheat design. All equipment was installed in ~1986 and is now 26 years old and at the end of its useful life. While the equipment appears to be well maintained, and the AHU's have been retrofitted with VFD's, the building operates inefficiently at a rate of $3.63/SF-Year and 106 kBTU/SF-Year (based on 2009 utility bills). A modern, energy efficient office building operates at $1.50/SF-Year and 50 kBTU/SF-Year.

The Cupertino City Hall has a small server room that is cooled by split system AC units, with air-cooled condensers located on the roof. The AC units for the server room appear to have been installed more recently that the rest of the HVAC equipment.

Figure 5A (Closed-Circuit 70 Ton Cooling Tower)

Figure 5B (Water-cooled 70 Ton Chiller)

In the lower level mechanical room, maintenance clearances and an exit pathway may not exist throughout the space. In addition, the combination of chiller, gas boiler, electrical gear, and generator equipment do not meet today's code

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requirement to have separate rooms for each of these pieces of equipment. The room is also not equipped with a refrigerant detection and exhaust systems currently required for chiller rooms, and the combustion air ducts in the boiler room need to be routed to an outdoor location.

Figure 5C (Gas Fired Boiler)

Figure 5D (Server room AC unit (1 of 2))

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Recommendations

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: Upgrade all duct, pipe, and equipment anchorage and seismic attachments to building structure. Replace duct and pipe connections with flexible joints where required.

Alt #3 Moderate Upgrade: Replace existing HVAC equipment with smaller, more efficient, better comfort equipment design.

Alt #4 Replacement: New HVAC systems for new building.

5.3.2 Ventilation

The existing AHU's air intake is located in an airwell that does not provide good air quality air for building occupants. The amount of fresh air brought into the building is not enough by today's standards and codes, and should be increased and improved.

Recommendations

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: No work.

Alt #3 Moderate Upgrade: Obtain fresh air from a different location (i.e. roof louvers) and increase amount of fresh air.

Alt #4 Replacement: New HVAC systems for new building.

5.3.3 Controls

The existing control system is and outdated pneumatic system that does not allow for remote monitoring or the implementation of common energy efficiency strategies in modern buildings. In addition the pneumatic controls system requires more maintenance to upkeep the compressor, air filter, and other mechanical systems required to run the system.

Recommendations

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: No work.

Alt #3 Moderate Upgrade: Replace existing system with modern DDC controls system.

Alt #4 Replacement: New HVAC systems for new building.

5.4 Plumbing Systems

5.4.1 Plumbing Fixtures

The existing plumbing fixtures are functioning and meet current code.

Recommendations

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: No work.

Alt #3 Moderate Upgrade: No work.

Alt #4 Replacement: New plumbing systems and fixtures for new building.

5.4.2 Domestic Water System

The domestic water piping appears to be copper. An AO Smith boiler gas fires water heater provide domestic hot water to all building plumbing fixtures. The water heater appears to have been installed with the last 5 years.

Recommendations

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: Upgrade all plumbing pipe and equipment anchorage and seismic attachments to building structure.

Alt #3 Moderate Upgrade: Replace existing plumbing pipe (cold and hot water). Replace existing water heater with a high efficiency heat pump water heater.

Alt #4 Replacement: New plumbing systems and fixtures for new building.

5.5 Fire Protection Systems

5.5.1 Fire Sprinkler system

The bulling is fully sprinklered and testing station appears to be in proper operating condition given the test log dates.

Recommendations

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: Upgrade all fire protection pipe and equipment anchorage and seismic attachments to building structure.

Alt #3 Moderate Upgrade: Replace existing pipe and sprinkler heads inside building to match renovation intent.

Alt #4 Replacement: New fire protection system for new building.

5.6 ELECTRICAL

5.6.1 Electrical Systems Summary

This report is an evaluation of the Cupertino Essential Services building electrical systems, located at Rodrigues and Torre Avenue, in Cupertino, California. The data used to develop this report was collected during one site visit conducted on February 15, 2012, as well as interviews of the staff working at the building. During the field visit, we observed the site conditions and systems exposed to visual observation. No testing or destructive investigation was performed.

Additional information about the building's power distribution system was gathered by reviewing the building plan sets made available in PDF format. The walk through was intended to evaluate the effectiveness of the existing Electrical systems.

This report provides an overview of existing conditions of the electrical system, identification of potential weaknesses in the systems and suggested improvements to the systems.

All major electrical equipment appear to be original and in working condition. The main distribution equipment is nearly 47 years old and has past its expected useful life. The generator is nearly 34 years old and has passed its useful life.

The existing light fixtures are in serviceable condition. As a possible energy saving project, the building management may want to consider replacing the existing lights with more energy efficient T5, T8, LED, and compact fluorescent fixtures. Another energy saving technique would be to upgrade the lighting control system and incorporate occupancy sensors and/or daylight sensors in addition to using time clock controls.

The main service to the City Hall space is a rated at 1000A at 208V, 3-phase system and provides power for a load density of approximately 12.5 W (or 15.5 VA, using 0.8 power factor) per square foot for the entire building, which is adequate for the current loads.

5.6.2 Assessment of Existing Conditions

<u>**Normal Power**</u>

Utility Transformer

The building is fed from a utility transformer (PG&E) located outside the building.

Figure 1E (PG&E Transformer)

The secondary power from the transformer to the main switchboard is provided via (4) sets of 4" underground conduits.

The main switchboard is rated 1600A, 208/120V, 3-phase, 4-wire and is located inside the main electrical room.

General Condition

The transformer belongs to PG&E and was recently upgraded. It appears to be in good working condition.

Code Issues

No code issues.

Recommendation:

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: Confirm with PG&E if the new transformer meets current Seismic code

Alt #3 Upgrade: No work. Transformer was recently upgraded.

Alt #4 Replacement: Transformer was recently upgraded.

Main Switchboard

The Main Switchboard is rated at 2000A, 120/208V, 3 phase, 4 wire with a 1600A main breaker manufactured by Industrial Electric Manufacturing, Inc. The main switchboard is feeding a distribution panel via a 1,000Amp breaker. This switchboard serves the City Hall.

The table below summarizes the load on each panel.

Table 5.1 (Panel Load)

Name	Size	Load Serving
MSB	2000A Section	Library, Future Public Safety Building, ATS for Generator
Panel DP	1000A Section	PANEL F, PANEL C, PANEL A, PANEL E, PANEL B, PANEL D, PANEL G (MCC) CHILLER, Future E.O.C. Panel
G (MCC)	600A	Pump 1, 2, 3, 4, 5, 6, Cooling Tower Fan A/C Fan Basement A/C Fan 1st Floor A/C Fan 1st Floor Remote Radiator Fuel Pump

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Figure 5F (Main Switchboard)

General Condition

The main switchboard appears to be of the original construction and in working condition, although past its useful life. In general, the switchboard is adequately sized to support the existing loads.

Code Issues

Maintenance clearances and exit pathway are required to be investigated around the 1600 Amp electrical panel. Electrical panel is over 1200 Amps, thus requiring either (A) 2 exits with panic hardware, or (B) 1 exit door with panic hardware but a clear and unobstructed path from Panel to exit door, or (C) a single exit door with panic hardware but double the required working space around the Panel.

Recommendation

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: Provide adequate support suitable for the seismic and earthquake condition.

Alt #3 Upgrade: The existing main distribution switchboard shall have regular preventative maintenance procedure per NETA (National Electrical Testing Association) standards.

Megger test existing feeders.

Test overcurrent protective devices in the switchboard for proper operation.

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Alt #4 Replacement: In order to ensure reliable power distribution to the building and reduce service needs in the future, we recommend the main switchboard be replaced with a new model.

5.6.3 Emergency Power

The emergency power system consists of a generator rated at 125KW, 208/120V and is located inside the main electrical room. The fuel tank, with 1000 gallon capacity, is located outside the room. In the event of a power outage, the generator provides power to the panel DP via a 400A automatic transfer switch (ATS) located in the main electrical room. The generator also provides power to the Chiller but the pump must be "jump" to move chilled water. The generator does not serve the existing elevator. or the chiller, as confirmed by discussions with facility personnel.

Figure 5G (Indoor Generator)

General Condition

The generator was installed in 1978, making it nearly 34 years old, which has exceeded its useful life. It appears to be operational, as confirmed by facility personnel.

Code Issues

No code issues

Recommendation

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: Provide adequate support suitable for the seismic and earthquake condition.

Alt #3 Upgrade: The generator should at the minimum be tested per manufacturer's recommendation to confirm its operation, and the batteries tested to confirm capacity and condition as well.

Alt #4 Replacement: The existing generator is currently loaded to its full capacity. In order to increase reliability and provide assurance of operation in the future, it is recommended that the generator be replaced with a new unit. We also recommend upsizing the generator to 175kW or above and its associated automatic transfer switch to 500A or above to provide capacity to serve additional loads such as the elevator and any future loads.

5.6.4 Grounding System

The service ground was not readily visible at the Main Switchboard. Feeder and branch circuit ground conductor sizes were not verified. Bonding to the building mechanical systems was not confirmed.

General Condition

No hazard has been identified with the current grounding system.

Recommendations

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: No work

Alt #3 Moderate Upgrade: The grounding electrode resistance should be verified and supplemented as needed with additional ground rods. The mechanical and plumbing system bonding should be verified.

Alt #4 Replacement: Provide new grounding system to meet current code.

5.6.5 Lighting

Interior Lighting

The existing lighting system consists mostly of recessed and pendant mounted fluorescent linear T8 32/26 watts source fixtures, with additional recessed incandescent downlight fixtures.

Illumination levels were observed to be uniform and adequate in all common area corridors, offices, work areas, and equipment rooms. Emergency exit signs are provided throughout the building according to Code. Emergency and egress lighting is provided by selected normal fixtures fed by emergency circuits from the generator.Exit lights are LED with battery back-up. Bug-eye type supplemental emergency fixtures was provided in the boiler room.

General Condition

Light fixtures appear to date back to the original construction and are in fair condition, with no operational issues.

Code Issues

Perform functional testing of all existing emergency lighting and measure light levels for code compliance.

Install additional emergency lighting as necessary after the functional testing of the existing installation to provide current code required minimum egress illumination.

Recommendations

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: Provide adequate support suitable for the seismic and earthquake condition.

Alt #3 Moderate Upgrade: If improvements to the lighting system are to occur, the existing outmoded T12 source fixtures should be replaced with new higher efficiency T8, T5 or LED source fixtures to reduce energy usage. Newer fixtures will also provide better light distribution and higher uniformity to increase occupant comfort. Any existing incandescent source fixtures should be replaced with higher efficiency compact fluorescent source fixtures.

Alt #4 Replacement: Similar to Alternative 3

5.6.6 Lighting Controls

The existing general lighting is controlled by local switches located within the corridors and at the each room. Lighting in the Kitchen, bathrooms, stairwell and conference room “A” is controlled by motion sensors. Relay control panels provide time schedule control for corridors and general areas, and dimming equipment provides dimming functionality to meeting rooms.

Recommendation

Alt #1 No Upgrade: No work.

Alt #2 Min Seismic Upgrade: Provide adequate support suitable for the seismic and earthquake condition.

Alt #3 Moderate Upgrade: Ceiling mounted occupancy sensors can be added to individual rooms to automatically switch on one-half or all of the fixtures when occupancy is detected and switch off all fixtures when no one is present, to take advantage of irregular occupancy intervals. A time delay of 30 minutes or less can be used to minimize nuisance switching.

To meet current code, reduce energy use, and increase the effectiveness and flexibility of the lighting installation, it is recommended that automatic and multilevel lighting controls be installed in every space.

Alt #4 Replacement: As the perimeter office areas receive good access to daylight, ceiling mounted photosensors may used to provide automated dimming of the perimeter fixtures according to the amount of daylight available, further reducing the lighting load. The existing fluorescent source fixtures within the

perimeter daylight area will need to be provided with dimming ballasts in order to integrate with the photosensor input.

In addition, both occupancy sensing and daylight harvesting through photosensors can be employed together. This will keep lights off when the space is unoccupied and also dim the light output when sufficient daylight is available in order to maximize the energy saving potential.

Meeting Minutes

By:	Haji Ishikawa	Date:	2/15/2012
Meeting Date:	2/14/2012	Project Name:	Cupertino City Hall Essential Services Facility Study
Meeting Time:	10am - 1pm	Project No.:	491204.000
Meeting Location:	Cupertino City Hall Conference Room C	Attendees:	*See Attached Sign-In Sheet*
Next Meeting Date:	2/21 1:30pm-2:30pm Conference Call		

Discussion

Items in **bold** are new, items in *italics* are revised.

Item No.	Description	Responsibility	Status
Introductions and Scope of Work			
2012-02-14.01	Goal of the study is to evaluate Essential Facilities status of the current Emergency Operation Center (EOC) in the City Hall can be maintained by: 1) Upgrade the building to meet the code requirement, OR 2) Relocate EOC out of the City Hall If any options are desirable the City will be incorporating into the master plan.	Information Only	n/a
2012-02-14.02	Carmen (Project Manager, Public Works) and Haji (Perkins + Will) will be the day-to-day contacts between the City team and the consultants team.	Information Only	n/a
Review of Reference Documents			
2012-02-14.03	3 CDs with the record pdf drawings from the 1965, 1987 construction, and the current exit plan diagrams were handed to the consultant team. P+W to share with the consultants team.	P+W	Closed 2/15
2012-02-14.04	There are additional retrofit work after 1987 renovation: • Council Room area, Main Floor • NW Open Office, Main Floor • SW Storage area, Basement Consultants to refer to the current exit plans for these revisions.	Information Only	n/a

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Item No.	Description	Responsibility	Status
Deliverables			
2012-02-14.05	Priority in architectural analysis will be items associated with Fire & Life Safety.	Information Only	n/a
2012-02-14.06	The City intends to bring Nova Partners to the project to provide cost estimating service.	Information Only	n/a
2012-02-14.07	The City identified the following additional information and concerns for the consultants team to better understand the context. 1) The wall opening near west corridor on the main level has rating issue. It affected the occupancy certificate of the 1987 renovation. 2) The weight of the tile roof is not helping the structural capability. 3) The City is looking for clean and efficient means of achieving what is required. 4) The operation cost of the current building is substantially high. Although a specific energy savings target has not been established, the City is interested in improvement. The City will share the energy study report for the MEP consultants to review. 5) The City experiences temperature control difficulty for the occupants, especially during the transition of the seasons. Some occupants use portable space heaters. 6) Adaption of a new accessibility code is forthcoming. Concerns on discrepancies between the federal (Dept. of Justice) standard and CBC Ch. 11 were discussed. For this study the consultants team will use **2010 CBC**. 7) In addition to the study based on **2010 CBC**, the consultants team will identify the foreseeable potential issues that can be effected by the 2013 CBC adaption. 8) Electrical use is currently maxed out. The 1987 renovation gave some improvement. 9) The City shared the idea of installing solar panels on the roof. 10) PG&E has upgraded the transformer serving the building. 11) The current plan does not provide visual access to the most heavily used areas for the visitors. A receptionist is required at the lobby. 12) The City is looking for a holistic solution if EOC needs to be relocated. 13) In order to have a new City Hall the current building needs to be either deficient or unfixable. 14) The current parking satisfies only 54% to 84% of the demand. 15) IT related space needs expansion and improvement in function. 16) The server room at NW corner provides capacity for buildings beyond the City Hall. 17) Solid proposal /options are required to be developed before submittal to the council. 18) The City will provide the environmental hazard report to	Information Only	n/a

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Item No.	Description	Responsibility	Status
	the consultant team. 19) The City experienced a flood problem in the sunken terrace area and the basement; however the existing sump tank should be sufficient.	Information Only	n/a
Schedule and Milestones			
2012-02-14.08	The proposed milestone works with City's subsequent activities. • 2/14 (Tue) Site Visit and kick-off Meeting • 2/21 (Tue) Clarifications Conference Call • 2/28 (Tue) Issue Electronic Rough Draft • 3/5 (Mon) Rough Draft Comment Response Conference Call • 3/9 (Fri) Final Report • 3/13 (Tue) Cost Estimate Meeting (to be confirmed)	Information Only	n/a
Other Issues			
2012-02-14.09	City encourages the consultants' team to lead the process for delivery of the report.	Information Only	n/a

End of Document

Sign In Sheet

Organization	Name	Title or Role
PERKINS WILL	HAJI ISHIKAWA	SENIOR PROJ ARCHITECT
City of Cupertino	Terry Greene	City Architect
City of Cupertino	Carmen Lynaugh	Project Manager
CITY OF CUPERTINO	LARRY SUNGARCIA	SENIOR BUILDIN
	ALBERT SALVADOR	BUILDING OFFICIA
	ARNOLD HOM	PLAN CHECK ENGR
PAE Consulting Engineers	Hooshang Pakzadan	Associate - Electrica
City of Cupertino	Timm Borden	Director of Public Wo
CITY OF CUPERTINO	CHRIS ORR	FACILITIES SUPERVISOR
"	Rick Kitson	Public & Env Affairs Di
PAE CONSULTING ENGINEERS	MARCO ALVES	MECHANICAL ENGIN
AKH STRUCT. ENG. INC	Tim Hyde	PRESIDENT
PERKINS+WILL	Karen Alschuler	Principal
PERKINS+WILL	Susan Seastone	Senior Project Manager

F:\Work\Cupertino\CCH Meeting Agenda 2012-02-14.docx

+↗ www.perkinswill.com

From: Ishikawa, Haji
Sent: Tuesday, February 21, 2012 6:05 PM
To: Terry Greene (TerryG@cupertino.org) (TerryG@cupertino.org)
Cc: 'hyde@akhse.com' (hyde@akhse.com); Hooshang Pakzadan (hooshang.pakzadan@pae-engineers.com); Marco Alves (marco.alves@pae-engineers.com); Seastone, Susan; carmenl@cupertino.org
Subject: Cupertino City Hall: Target Alternatives

Terry,

Below is the key scope items of the four different alternatives that we discussed in the teleconference today. I would like to share this with the consultants team as a target to sort out our recommendations after the analysis is done. Please let us know if you have any comments. For the Alt #4, my assumption is a new construction after demolition of the existing building. Please clarify.

Facility Improvement Alternatives

Alt #1 No Upgrade

- Relocation of EOC

Alt #2 Min Seismic Upgrade – with items triggered by I factor improvement

- Replacement of roof tile – as maintenance
- Possible adjustment of roof profile & equipment screen
- Connection of collector beam and concrete shear wall
- Additional concrete wall to the main level, if req'd. (should not affect floor plan and egress)
- Ducts & equipment seismic support (per I factor change)
- 20% of cost for ADA upgrade

Alt #3 Moderate Upgrade

- All Alt #2 items
- Fire & Life Safety upgrade to meet 2010 CBC
- MEP upgrade to meet operation requirements as Essential Services Facilities
- Energy efficiency to meet performance of the existing building
- ADA upgrade

Alt #4 Replacement –New Construction

- Meet all the current codes
- Improve architectural and planning issues

Thank you,
Haji

Haji Ishikawa, AIA, LEED AP BD+C

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Perkins+Will. Ideas + buildings that honor the broader goals of society

From: Ishikawa, Haji
Sent: Thursday, February 16, 2012 10:37 AM
To: Marco Alves (marco.alves@pae-engineers.com); 'hyde@akhse.com' (hyde@akhse.com)
Cc: Seastone, Susan
Subject: Cupertino City Hall: Additional Information

Marco, Tim,
After the Tuesday meeting Terry Greene mentioned his expectation of the range of recommendations. We need to further get into the study before deciding the format, but I'd like to share his input with you.

1. Do nothing – I understood this means relocation of the EOC
2. Min renovation – Likely limited to structural scope
3. Moderate renovation – Terry hopes that this doesn't trigger full ADA upgrade (by exceeding $129,000 construction cost). But from structural point of view Tim thinks even the option #2 min renovation could exceed the threshold.
4. Substantial Renovation – I understand this would improve most of the City's concerns expressed in the meeting (and beyond) to make the building more efficient and functional.

We will be issuing the minutes from Tuesday kick-off this shortly. I have also started a simple architectural code summary of the existing building. I will share with both of you by the end of the day today.
Thanks,
Haji

Haji Ishikawa, LEED AP BD+C

Senior Project Architect
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Perkins+Will. Ideas+ buildings that honor the broader goals of society

The following document was provided by the City of Cupertino. The MEP Study was prepared by PAE Consulting Engineers, Inc. for Perkings + Will in September 30th, 2014.

PAE

Cupertino City Hall: MEP Systems Alternatives Study

September 30, 2014

City of Cupertino
CIP Project # 2013-07
File # 51,045.53
Section # 2.10

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1.0 Project Description

This report is a follow up to the "Cupertino City Hall Essential Services Facility Analysis" report produced on 3/27/2012 by Perkins + Will, AKH Structural Engineers, and PAE. Refer to the 2012 report for details information on existing systems.

At this time the design team is considering 5 options for the city hall building:

1. Option A – Upgrade city hall with life safety
2. Option B – Upgrade city hall with life safety + EOC
3. Option C – Gut and remodel city hall
4. Option D – New city hall building with basement parking
5. Option E – New city hall building with basement parking + council chambers

The following sections outline the Mechanical, Electrical, and Plumbing implications of each of the above options. TBD Consultants has been engaged to provide cost estimates of each of these options.

2.0 OPTION A - UPGRADE CITY HALL WITH LIFE SAFETY

2.1 Electrical

Existing Electrical equipment including Main Switchboard, panelboards, etc. are all well past their useful life. Replace all Electrical distribution equipment.

Existing wiring to be removed and new wiring to be pulled through existing conduit.

Upgrade Fire Alarm to meet the latest Life Safety requirements.

Provide new lighting fixtures to meet the latest T24 requirements. Emergency power for egress fixtures, via local battery packs.

2.2 Mechanical

Demo existing 70-ton, 1986 vintage water cooled chiller in lower level mechanical room.

Demo existing 70-ton, closed circuit, 1986 vintage rooftop cooling tower.

Demo 1965 vintage gas fired non-condensing boiler in lower level mechanical room.

Demo lower level 1986 vintage VAV+ reheat air handling unit.

Add new 70 ton air-cooled chiller at roof/attic level.

Add (2) 400,000 Btu (input capacity) boilers at basement level.

Add new pipe and pumps for chilled and hot water systems.

Add (2) new AHUs to basement level (15,000 cfm each).

Clean and reuse existing ductwork as much as possible.

Increase ventilation rate to today's standards, re-route ventilation air intake.

2.3 Plumbing

No work.

2.4 Indirect Costs

Cost of building/locating the EOC elsewhere on campus. Council Chambers remains at the Community Hall. The operations of the facility is not included in the costing.

3.0 OPTION B - UPGRADE CITY HALL WITH LIFE SAFETY + EOC

3.1 Electrical

Existing Electrical equipment including Main Switchboard, panelboards, transformers etc. are all well past their useful life. Replace all Electrical distribution equipment.

Existing wiring to be removed and new wiring to be pulled through existing conduit.

Existing Generator is well past it's useful life. Replace with new generator.

Evaluate Generator capacity versus the latest EOC requirements. Minimum generator size to be 125kW to match existing size.

Upgrade Fire Alarm to meet the latest Life Safety requirements.

Provide new lighting and lighting controls to meet the latest T24 requirements. Emergency power for egress fixtures, via local battery packs.

3.2 Mechanical

Same points as Option A, also including the following:

Upgrade all duct, pipe, and equipment anchorage and seismic attachments to building structure. Replace duct and pipe connections with flexible joints throughout. All large equipment shall be spring isolated.

AHU to be placed in attic level or roof. Preliminary selection indicates (2) AHU's at 7'W x 28'L x 5'H (10,000 lbs each).

Add HVAC heating to generator load (AHU, Boiler, Pumps, will be on emergency power, connected to the generator).

3.3 Plumbing

Upgrade all plumbing equipment and pipe anchorage and seismic attachments to building structure.

3.4 Indirect Costs

Cost of operating the Council Chambers at the Community Hall is separate.

4.0 OPTION C - GUT AND REMODEL CITY HALL

4.1 Electrical

Existing Electrical equipment including Main Switchboard, panelboards, transformers etc. are all well past their useful life. Replace all Electrical distribution equipment.

Provide new Electrical Distribution throughout the building. This includes new Main Switchboards, panelboards, and transformers.

Provide new conduits to distribute power.

New wiring

Existing Generator is well past it's useful life. Replace with new generator.

Evaluate Generator capacity versus the latest EOC requirements. Minimum generator size to be 125kW to match existing size.

Upgrade Fire Alarm to meet the latest Life Safety requirements.

Provide new lighting and lighting controls to meet the latest T24 requirements. Emergency power for egress fixtures, via local battery packs.

4.2 Mechanical

Same points as Option B, also including the following:

New thermal zoning layout.

New distribution ductwork.

New distribution piping.

Design for mixed mode natural + mechanical ventilation, possibly engaging light wells or light court for transfer air.

All new mechanical system is likely to remain an air based VAV + reheat system.

4.3 Plumbing

Provide new high efficiency, condensing gas water heater.

Provide all new piping for the following systems:

a) Domestic Cold and Hot water piping

b) Vent piping

c) Gas piping

d) Storm piping

e) Waste piping

Provide new (water conserving) plumbing fixtures.

4.4 Indirect Costs

Cost of operating the Council Chambers at the Community Hall is separate.

5.0 OPTION D - NEW CITY HALL BUILDING + BASEMENT PARKING

5.1 Electrical

New incoming service

New distribution

New Lighting

New Generator

New Fire Alarm

5.2 Mechanical

New central hydronic equipment: geothermal slinky field (60,000 sf area) below basement parking, served by water to water heat pump.

- Take advantage of federal tax savings for geothermal systems: 10% Tax Credit year 1, and 100% depreciation over 5 years.
- City of Cupertino to determine tax liability and eligibility for tax savings programs. One option may be a Thermal Purchase Agreement (TPA) in which a tax-liable 3rd party procures the geothermal system and secures the tax savings, and the City of Cupertino purchases the thermal energy from the 3rd party.

New indoor services, including radiant heating/cooling with dedicated outdoor air system.

Garage ventilation with CO sensor control.

5.3 Plumbing

New incoming/outgoing services for Fire, Gas, Domestic Cold Water, Storm Drain, and Waste.

New high efficiency condensing gas water heater and associated components (recirculating pump, storage tank, expansion tank, etc.)

New water conserving plumbing fixtures.

New plumbing piping systems.

5.4 Indirect Costs

Cost of operating the Council Chambers at the Community Hall is separate.

6.0 OPTION E - NEW CITY HALL BUILDING + BASEMENT PARKING + COUNCIL CHAMBERS

6.1 Electrical

Same as Option D

6.2 Mechanical

Same as Option D, with higher ventilation rates and equipment capacities and geothermal slinky field (70,000 sf area).

6.3 Plumbing

Same as Option D

6.4 Indirect Costs

Assume EOC included.

7.0 ENERGY BENCHMARKING

Based on 2009 utility bills, the existing facility operates inefficiently at an energy cost rate of $3.63/sf-year and an Energy Use Intensity (EUI) of 106 kBTU/sf-year. A modern, energy efficient new construction office building in this climate would operate at approximately $1.20/sf-year and 35 kBtu/sf-year.

Based on PAE's project experience, Figures 1 and 2 on the next page illustrate potential reductions in energy use and energy cost associated with each of the options described in this report. Figures 3 and 4 illustrate preliminary life cycle cost analysis and total cost of ownership for the mechanical systems described in Options A-E.

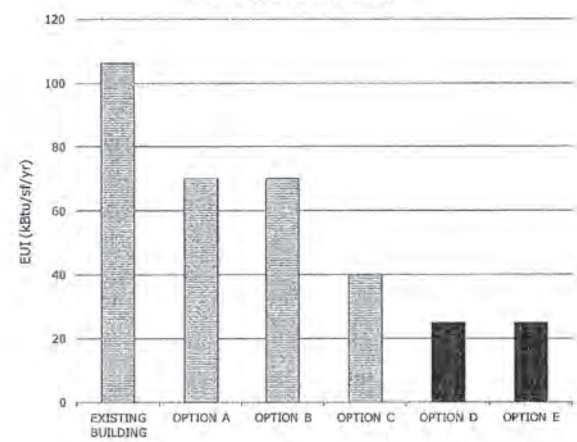


Figure 1. Energy Use Intensity (EUI) comparisons

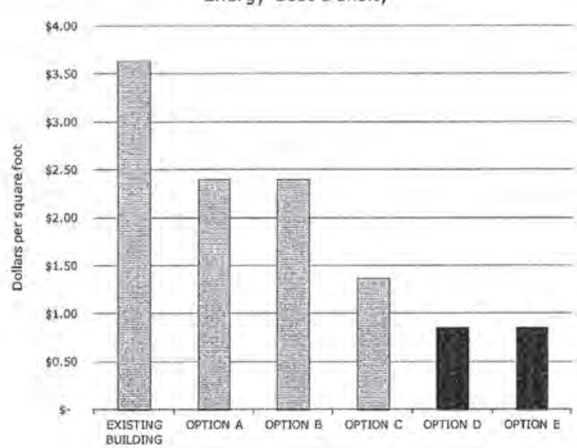


Figure 2. Energy Cost Density comparisons

LIFECYCLE COST ANALYSIS

BASED ON 30 YEAR ANALYSIS : 2013 to 2042

Option	OPTIONS	Capital Costs ($)2014	Avg. Maint. Costs ($)	Avg. Repla. Costs ($)	Utility Costs ($)2014	Savings By Design Rebate ($)2014	Payback T24 Base (Years)	15 Year Cost of Ownership ($)2028	30 Year Cost of Ownership ($)2043	Energy Use Index (kBtu/sf-yr)
A	Option A - UPGRADE CITY HALL WITH LIFE SAFETY	$2,274,829	$79,292	$39,808	$55,200	$0	-	$4,542,765	$9,282,821	70
B	Option B - UPGRADE CITY HALL WITH LIFE SAFETY + EOC	$2,500,000	$79,292	$43,779	$55,200	$25,545	0	$4,295,537	$9,166,827	70
C	Option C - 4.0 OPTION C - GUT AND REMODEL CITY HALL	$3,273,005	$47,575	$43,779	$31,510	$0	11	$4,210,913	$7,439,933	40
D	Option D - 5.0 OPTION D - NEW CITY HALL BUILDING + BASEMENT	$4,600,000	$23,788	$43,779	$19,780	$25,545	8	$4,980,263	$7,248,424	25
E	Option E - 6.0 OPTION F - NEW CITY HALL BUILDING + BASEMENT PARKING + COUNCIL CHAMBERS	$4,600,000	$23,788	$43,779	$19,780	$27,556	23	$4,978,251	$7,246,413	25

Notes / Assumptions:

1. THESE VALUES ARE PRELIMINARY RESULTS ONLY. THIS ANALYSIS WILL BE UPDATED WITH FINAL COST INFO FROM TBD CONSULTANTS.

Figure 3. Life Cycle Cost Analysis Results

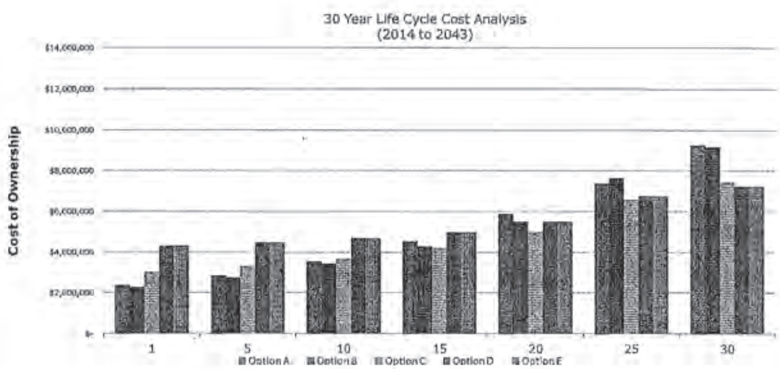


Figure 4. Total Cost of Ownership over 30 years

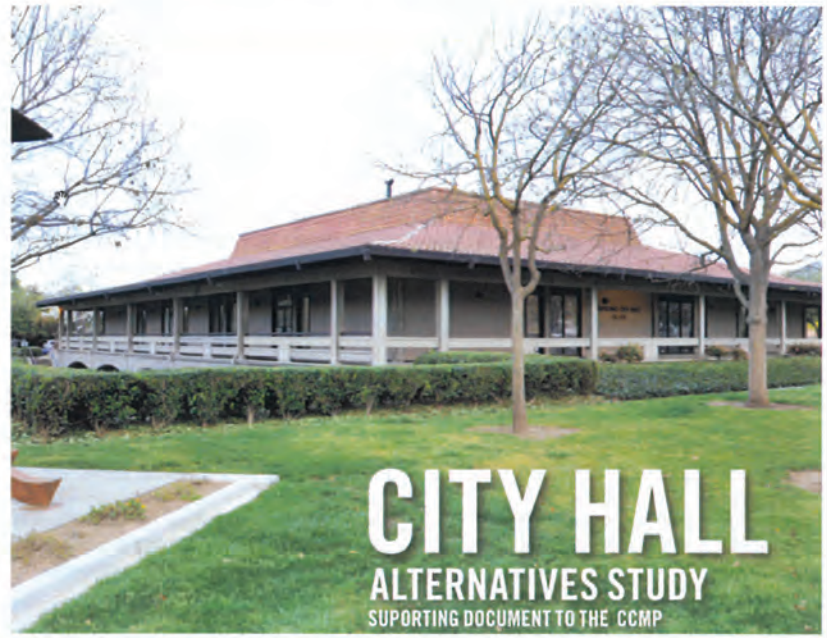
STRUCTURAL STUDIES | **2014 STRUCTURAL EVALUATION**

The following document was provided by the City of Cupertino. The structural evaluation was prepared by Tipping Mar Structural for Perkings + Will in September 29th, 2014.

TIPPING | MAR *STRUCTURAL ENGINEERING*

Cupertino City Hall Alternates Study Structural Evaluation:

10300 Torre Avenue, Cupertino, CA 95014-3202



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Perkins + Will
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c/o City of Cupertino

September 29, 2014

City of Cupertino
CIP Project # 2013-07
File # 51,045.53
Section # 2.10

Executive Summary

Five alternative options have been discussed for the future of the City Hall, with various degrees of improvement, from performing the minimum amount of architectural remodel and structural strengthening to a brand new replacement building with additional underground parking. The first three options involve the seismic strengthening of the existing structure. This report will focus primarily on those three options, evaluated under the reference standard ASCE41-13 "Seismic Evaluation and Retrofit of Existing Buildings".

The proposed strengthening scheme for Option A involves structural strengthening of the building's seismic force resisting system to satisfy a life safety performance objective and includes minimal architectural remodeling. The limited level of seismic strengthening associated with this option will require the emergency operations center (EOC) to be relocated to another location. As part of this retrofit option, we have confirmed that the strengthening recommendations contained in the "Cupertino City Hall Essential Services Facility Analysis", dated March 27, 2012, could be implemented. The only exception would be the concrete column strengthening could be less intrusively achieved with the addition of new adjacent steel columns in lieu of fiber wrap. The new steel columns would act as secondary support members in the event of seismic related damage to the existing concrete columns. Seismic improvements would also include non-structural elements such as suspended ceilings, partition walls, and glazing systems. These elements would require bracing to seismically strengthen their connections and the replacement of any non-tempered glazing.

The proposed strengthening scheme for Options B and C both involve retrofitting the existing city hall to an immediate occupancy performance objective. This performance objective would allow the EOC to be retained within the existing city hall building. Option B would involve less architectural remodeling, whereas Option C would entail a complete architectural remodel. Option C would allow for a new, large light court in the center of the building, thus requiring additional structural modifications to both the roof and floor level gravity framing systems. Seismically, the structural deficiencies for both of these options are the same as those for Option A above. All options require strengthening the existing roof diaphragm, roof girder collector splice connections, roof girder to shear wall connections, adding additional length of concrete shear wall from the first floor level to the roof, strengthening the exterior colonnade connection to the roof framing, and strengthening the existing concrete columns to withstand anticipated seismic displacements.

Options B and C will require a more extensive strengthening of these elements than Option A, given the more stringent performance objective. As with Option A, non-structural elements will also require strengthening. To achieve immediate occupancy, these element would have to be designed to have only minimal, limited damage after a seismic event. This may be difficult to achieve with the existing building materials to be retained in Option B. In Option C, these elements will be constructed anew, and can be explicitly designed for an immediate occupancy performance objective. Finally, it should be noted that any retrofit intended to achieve an immediate occupancy performance objective will be met using prescriptive code methods that merely increased the force level demands on seismic resisting elements. This prescriptive code based approach does not necessarily assure that the performance goals of uninterrupted operation and immediate occupancy will be met.

The construction of a new City Hall building, Options D and E, will offer the opportunity to design both the building's gravity and seismic force resisting systems for the specific performance objective of immediate occupancy. Options A, B, or C, aim to strengthen the old building by limiting damage to a structure that, even after a costly retrofit is undertaken, is still largely constructed in an antiquated manner. A new City Hall can be constructed with the latest state of the art seismic force resistance technologies, such as base isolation systems or passive energy dissipation devices which will result in a facility that is more earthquake resilient than a traditionally seismically retrofitted structure. Using state of the art, site specific, seismic modeling techniques and ductile detailing practices a greater degree of certainty regarding seismic performance can be intentionally built into the structure to assure that the city's critical service functions do not become interrupted after a large seismic event.

Existing City Hall Construction

The City Hall was originally built in the late 1960's as a one-story building with a full basement. The main roof is consisted of plywood sheathing over 3" tongue and groove decking over 6 and 8 inch timber beams. The timber roof beam are then supported by either steel or concrete girders. The roof framing for the central mechanical well is consisted of plywood sheathing over 2 in timber joists supported by steel beams. The central mechanical well is surrounded by 5' tall wood framed parapet. The main roof and the parapet are covered with clay roof tiles which represent a significant portion of the current roof's self weight and seismic mass. The structure was renovated as part of the Civic Center Improvements project in the mid 1980's. During the renovation, the north side of the basement was excavated to create a concrete terrace, approximately 20 wide, parallel to the building. Portions of the original north basement walls were removed to create new storefronts. An additional 6 inches of shotcrete was added to the remaining north basement wall. The current lateral force resisting system of the structure is 6 inch concrete shear walls above grade and 12 and 18 inch concrete shear walls in the basement. Concrete slab, joists, and girders make up the ground floor framing. Interior concrete columns extend from shallow pad footing foundations to the roof level. Perimeter concrete columns are supported by the basement walls. There is also a perimeter exterior colonnade framed with concrete columns and beams.

Structural Evaluation Methodology

The materials reviewed were the 1965 Cupertino City Hall structural drawings, 1986 Cupertino City Center Improvement architectural drawings, and the Cupertino City Hall Essential Services Facility Analysis Report dated March 27, 2012.

The methodology used to evaluate the existing City Hall structure and the associated retrofit schemes were based on American Society of Civil Engineers Standard 41-13 "Seismic Evaluation and Retrofit of Existing Buildings" (ASCE 41-13). ASCE 41-13 is a nationally recognized Standard that can be used as a tool to evaluate existing buildings and develop corresponding retrofit schemes. Although the seismic evaluation and retrofit of the existing City Hall is voluntary and the application of ASCE 41-13 is not mandatory, the use of this Standard is more appropriate than design code CBC 2013 that is intended primarily for new building designs. ASCE 41-13 takes into consideration of existing building's material properties, construction details, expected structural component and systems performance, and evaluates them against a selected Performance Objective. The main focus of this study was to evaluate Options B and C at a Performance Objective of Immediate Occupancy under a 20% probability of exceedance in 50 years seismic hazard (Basic Safety Earthquake-1E). Options B and C are classified as a Risk Category IV Essential Facility. A Linear Static Procedure was used for the evaluation and retrofit design. Soil Site Class D was assumed as a geotechnical report was not available at this time.

Seismic Evaluation and Retrofit Recommendations

Retrofit Option A

The objective of Option A is to relocate the EOC to another facility and upgrade the City Hall to a Life Safety Performance Objective under Basic Safety Earthquake-1E. Based on our findings from the existing structure's evaluations at the Immediate Occupancy Performance Objective level and a review of the performance requirements at the Life Safety level, the recommended structural retrofit would be one that is similar to the scheme proposed by AKH Structural Engineers in the "Cupertino City Hall Essential Services Facility Analysis dated March 27, 2012.

As discussed earlier in the report, the existing concrete columns are susceptible to seismic damage due to the limited amount and size of the confinement ties around the longitudinal reinforcement. The lack of confinement ties can limit the column's ductility, or ability to sway and remain undamaged during a seismic event. This limited ductility could cause the column to lose its gravity loading carrying capabilities and ability to provide continued support of the roof framing members. The existing concrete columns should be either paired with secondary steel columns to provide redundant gravity support capabilities or strengthened with fiber reinforced polymer to address this deficiency. The exterior colonnade columns can be fiber wrapped with minimal interruptions to other architectural elements. Where the wrapping activity may not be feasible, such as in areas adjacent to exterior facades, supplemental steel 6x6 columns at the perimeter and steel 8x8 columns at the interior may be placed adjacent to the existing un-wrapped columns to serve as the back-up gravity system.

To satisfy the Life Safety Performance Objective for non-structural components and systems, it is likely a seismic safety film (designed to hold shattered glass in place) will need to be applied to any existing non-safety, non-laminated annealed glass or the glazing panes themselves should be replaced. Additional tie wires for suspended ceiling grids and additional bracing and anchorage for interior partitions should be added to prevent extensive falling of ceiling tiles and wide spread collapse of partition walls during an earthquake. Mechanical systems should also be provided with a minimum level of seismic bracing, if not already in place, to prevent duct work and piping from posing a falling hazard to occupants. Finally, new or existing roof mounted equipment should be properly anchored to roof framing. This may, in some instances of heavy equipment, require additional localized strengthening of the roof framing members themselves.

Retrofit Options B and C

Evaluation of Structural Components

The main structural deficiencies for the existing City Hall are discussed below. These deficiencies are common for both Options.

- Roof diaphragm shear capacity
- Roof collector splice capacity
- Collector to shear wall connection capacity
- Shear wall flexural capacity and seismic detailing
- Concrete column ductility
- Porch colonnade to roof connection

Recommendations for Structural Strengthening

Roof Diaphragm Strengthening Measures

The existing heavy clay roof tiles make up a significant portion of the existing roof's self weight. As the building's seismic force demand is directly proportional to the self weight, it is recommended that the existing clay roof tiles be removed and replaced with a lighter roofing material. Even with the mass of the roof significantly reduced, the force demand on the roof diaphragm is near the capacity limit state for a plywood diaphragm given the shear forces associated with an immediate occupancy performance criteria.

As such, a new High Load Diaphragm will be required for the roof area outboard of the central mechanical well. New 3/4" plywood will be provided over the existing 1/2" plywood and 3x tongue and groove blocking with two rows of 10d nails @ 2 1/2" o.c. along diaphragm boundaries and continuous panel edges, 4" o.c. at other panel edges, and 12" o.c. in field. The existing diaphragm at the central mechanical well will be strengthened with 1 row of 10d nails @ 2" o.c. along diaphragm boundaries and continuous panel edges, 3" o.c. at other panel edge, and 12" o.c. in field. New 4x6 blocking will be added at continuous panel edges perpendicular to joist framing direction.

Roof Level Collector Strengthening Measures

There are several types of collector connections at the roof level, all of which require strengthening to increase their load carrying capacity. Where the existing roof diaphragm collectors are wide flange steel roof beams, they are currently spliced to each other with machine bolts. Theses splices will need to be strengthened with additional new splice plates and new welding as shown in on Sheet S3, Detail 2, of the attached building retrofit drawings. Where existing roof collectors occur at steel wide flange to wood girder locations, additional horizontal Simpson Holdowns or CMST straps are required to strengthen the existing steel beam to timber girder connections, as shown in Detail 1 of Sheet S3. The porch colonnade on the exterior perimeter of the building is constructed of concrete beams and columns. The anchorage connections between these beams/columns and the wood roof framing and diaphragm currently lacks a clear load path and does not have adequate capacity. New connecting members should be installed to provide proper anchorage between the colonnade and the roof diaphragm, as shown in Detail 4 of Sheet S3. Finally, the collector connections anchoring the steel beams to the tops of the existing concrete shear walls need to be strengthened. Additional anchor bolts will be added between existing shear walls and collectors. New shear walls will also be connected to the existing steel roof beam collectors with new anchor bolts.

Additional Concrete Shear Walls

Additional shear walls extending from foundations to roof should be added to provide new/strengthened vertical seismic force resisting elements for the existing structure. The new shear walls will typically be 12" thick concrete walls from the top of existing basement walls to the underside of the roof and 6" thick concrete walls that are overlapped and connected to the face of the existing basement walls with reinforcement dowels, as shown in Detail 3 of Sheet S3. Where the wall length is limited at the north elevation within the basement level, two new new pile caps, with two micro-piles at each cap, should be provided to increase the shear wall overturning resistance along this line and protect the existing very lightly reinforced foundation from associate seismic damage.

Strengthening the Existing Concrete Columns

The concrete columns are connected to all floor levels and to the roof. As such, they will deform as they drift with the rest of the building during an earthquake. Bending moments and shear forces will be induced in these columns as they sway with the building during a seismic event. The long span and inherent flexibility of the wood roof diaphragm will also contribute to the anticipated seismic roof drift making these under-reinforced columns very susceptible to seismic damage. The existing concrete columns have limited confinement reinforcement ties around the longitudinal reinforcements, as noted earlier in this report. Sufficient lateral ties are required in modern building codes to properly confine the longitudinal bars and the concrete core in order for the columns to continue carrying gravity loads when the columns are displaced. The lack of confinement ties is likely to result in limited displacement ductility for the concrete column. The existing columns are to be wrapped and strengthened with fiber reinforced polymer. Wrapping the existing columns will increase the displacement ductility for gravity load carrying capacity.

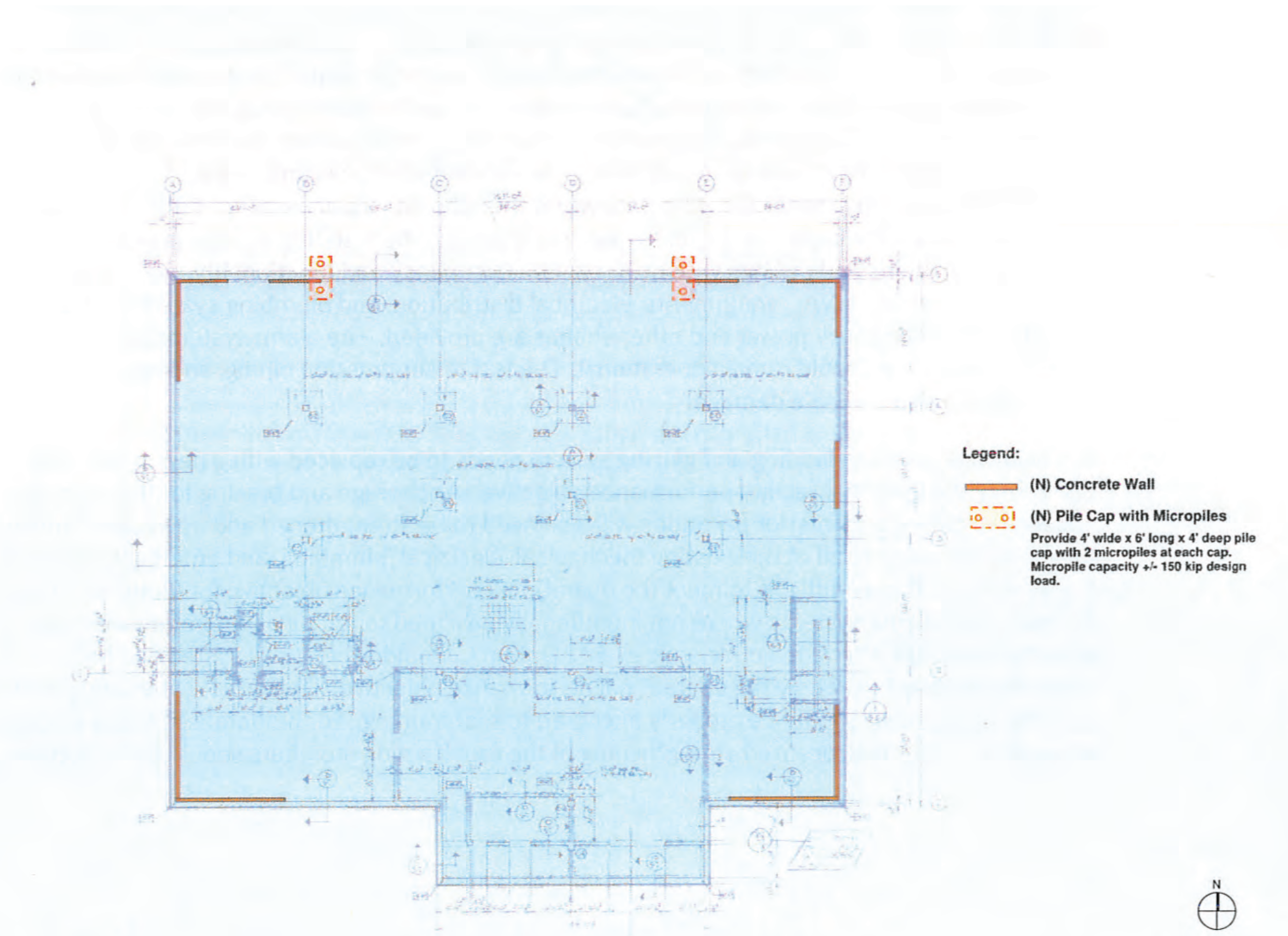
Structural Alterations for Option C

Additional gravity framing modifications also required for the installation of a large new light court and for the relocation of the building's elevator and stairs. Roof framing modifications such as new wood headers, blocking, and strapping are required around the new roof opening. Modifications to existing ground floor concrete framing will also be required to accommodate the new light court and various relocated stairs and elevators. These modification will include new concrete beams to support existing concrete joist framing that have had their existing support framing removed or modified. Retrofit support of gravity framing members often requires precision chipping of existing concrete surfaces, rebar coupling for reinforcment extensions, and welding of anchorage plates to properly anchor the ends of existing concrete members to new concrete supports.

Non-Structural Components and Systems for Options B and C

Existing anchorage and support details for the majority of the architectural, mechanical, electrical, and plumbing components are unknown. Additional as-built documents or site survey may be required to assess the building's non-structural components and systems conformance to the Performance Objective. The Nonstructural Performance Level for an Essential Facility should satisfy the ASCE 41-13 "Operational" Objective, where the nonstructural components and systems are able to perform the same functions they provided before the earthquake. Per ASCE 41-13, Tables C2-5 and C2-6, non-structural components, such as architectural, mechanical, electrical, and plumbing systems should have only negligible damage after a seismic event. There should be no loss of function to exterior cladding panels and they should remain weather-tight. There should not be any cracked or broken panes in the exterior glazing. There should only be negligible damage to interior partitions and ceilings with no impact on occupancy and functionality. Elevators will remain in operation. HVAC equipments, electrical distribution, and plumbing system remain operational if emergency power and other utilities are provided. Fire alarm systems and emergency lighting should remain operational. Ducts, fire suppression piping, and light fixtures should have only negligible damage.

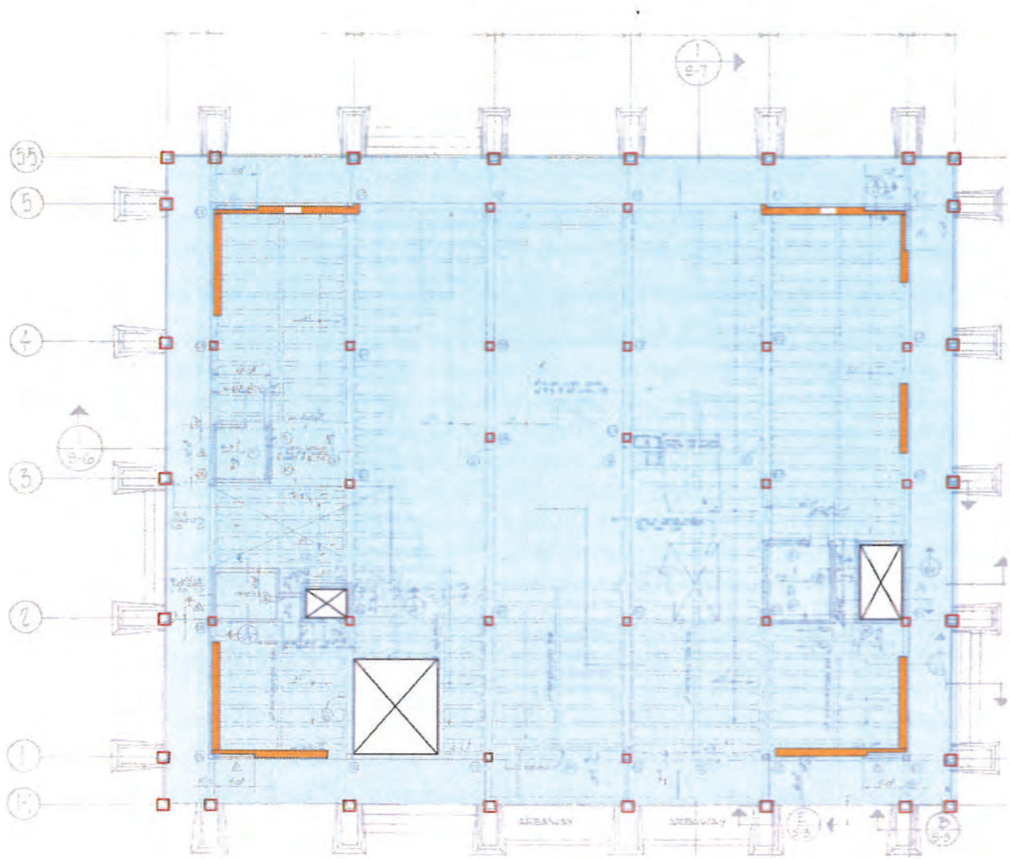
It is likely the exterior cladding and glazing system needs to be replaced with a new system that can satisfy the Essential Facility performance objective. Anchorage and bracing for the existing suspended ceiling and interior partitions will also need to be strengthened and upgraded. Similarly, the same will apply to all of the existing mechanical, electrical, plumbing, and emergency systems if they remain. It may difficult to meet the operational performance objective for Option B where the existing building systems where not intentionally designed to remain in operation with only negligible damage after a major seismic event. Option C would allow these systems to be explicitly designed to satisfy the operational performance objective. Finally, new or existing roof mounted equipment should be properly anchored to roof framing. For moderate to heavy pieces of equipment, additional localized strengthening of the roof framing members should be anticipated.



TIPPING | MAR
STRUCTURAL ENGINEERING
1906 Shattuck Ave. Berkeley, CA 94704
510 549-1906 510 549-1912 fax

Cupertino City Hall | Option B
Cupertino, CA
TM Project: 2014,094 Scale: As Noted

Terrace Level Plan
September 29 2014
S0



Legend:

(N) Concrete Wall

(N) FRP Wrap @ (E) Columns

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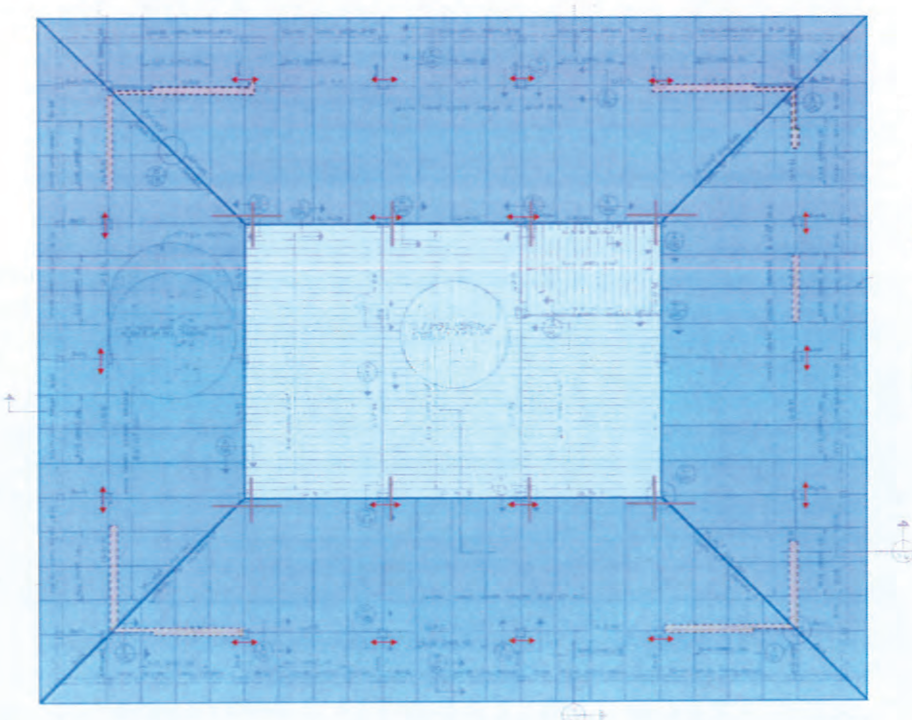
Cupertino City Hall | Option B
Cupertino, CA

TM Project: 2014,094 Scale: As Noted

Ground Floor Plan
September 29 2014

S1



Legend:

(N) Concrete Wall Below

(N) High Load Diaphragm
Provide (N) 3/4" Plywood over (E) 1/2" Plywood and 3X T&G Blocking w/ 2 Rows of 10d Nails @ 2 1/2" o.c. along diaphragm boundaries and cont. panel edges, 4" o.c. at other panel edges, and 12" o.c. in field

(E) Reinforced Diaphragm
Reinforce (E) 1/2" Plywood w/ 1 Row of 10d Nails @ 2" o.c. along diaphragm boundaries and cont. panel edges, 3" o.c. at other panel edges, and 12" o.c. in field. Provide (N) 4x6 min. blocking @ cont. panel edges perpendicular to framing direction, typ.

(N) Simpson CMST strap or Simpson Holdown

Retrofitted WF Steel Collector Connection

N

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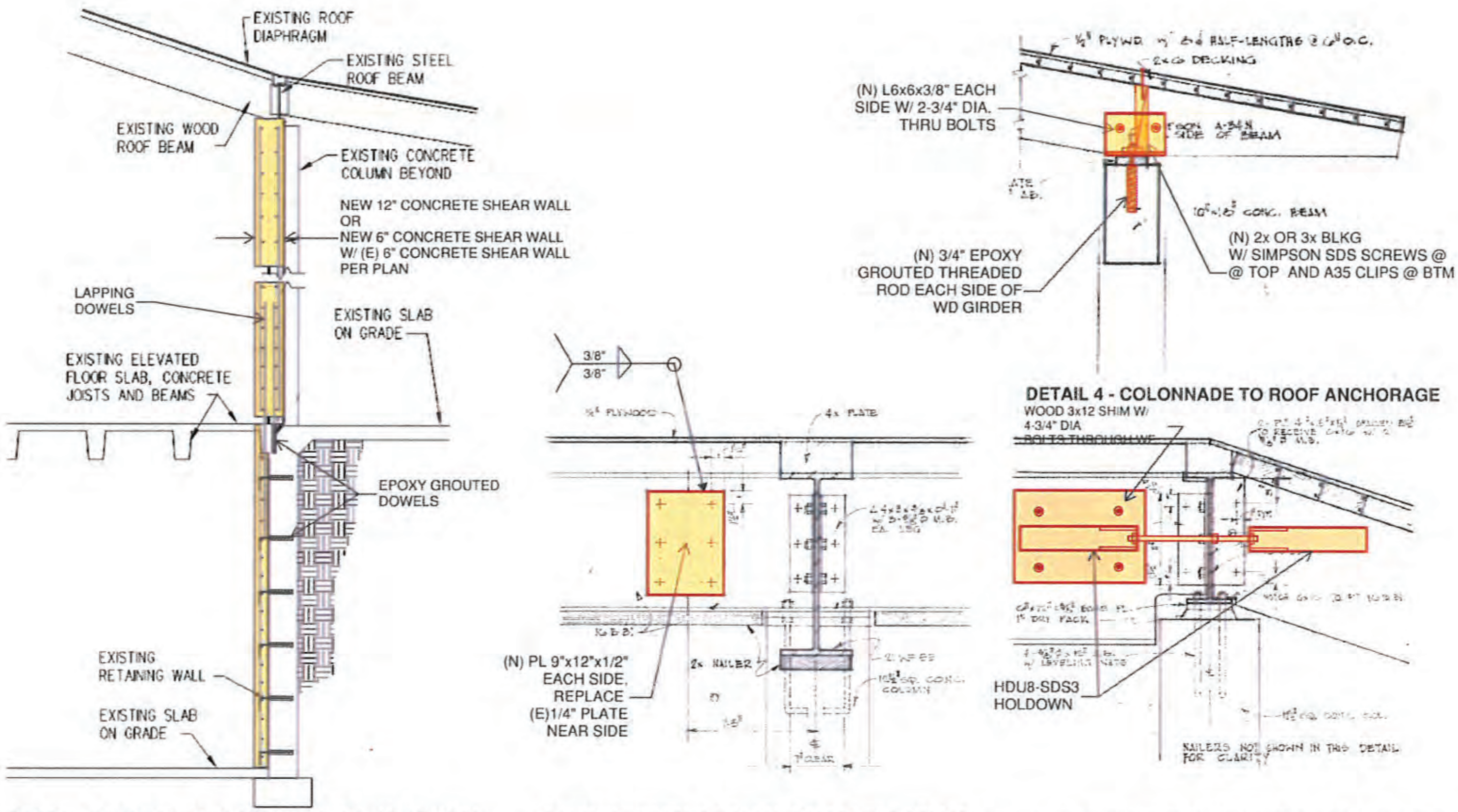
510 549-1906 510 549-1912 fax

Cupertino City Hall | Option B
Cupertino, CA
TM Project: 2014,094 Scale: As Noted

Roof Plan
September 29 2014
S2



DETAIL 3 - SECTION AT NEW CONCRETE SHEAR WALL

DETAIL 2 - STEEL TO STEEL COLLECTOR SPLICE

DETAIL 1 - STEEL TO WOOD COLLECTOR CONN.

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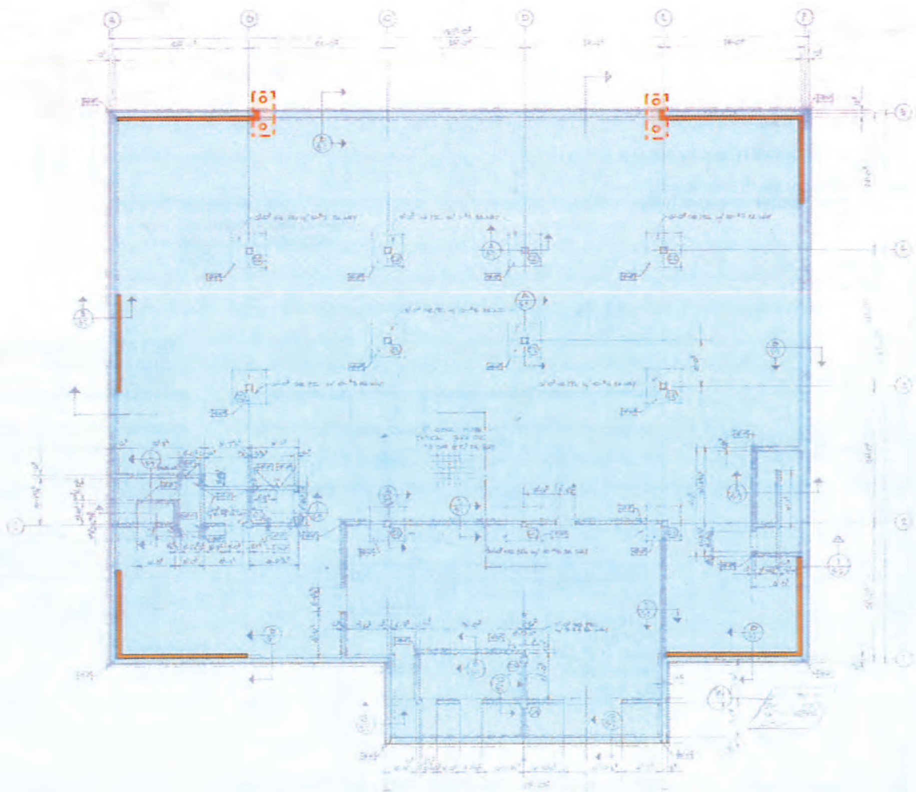
Cupertino City Hall | Option B
Cupertino, CA
TM Project: 2014,094 Scale: As Noted

Retrofit Details
September 29 2014
S3



Legend:

(N) Concrete Wall

(N) Pile Cap with Micropiles

Provide 4' wide x 6' long x 4' deep pile cap with 2 micropiles at each cap. Micropile capacity +/- 150 kip design load.

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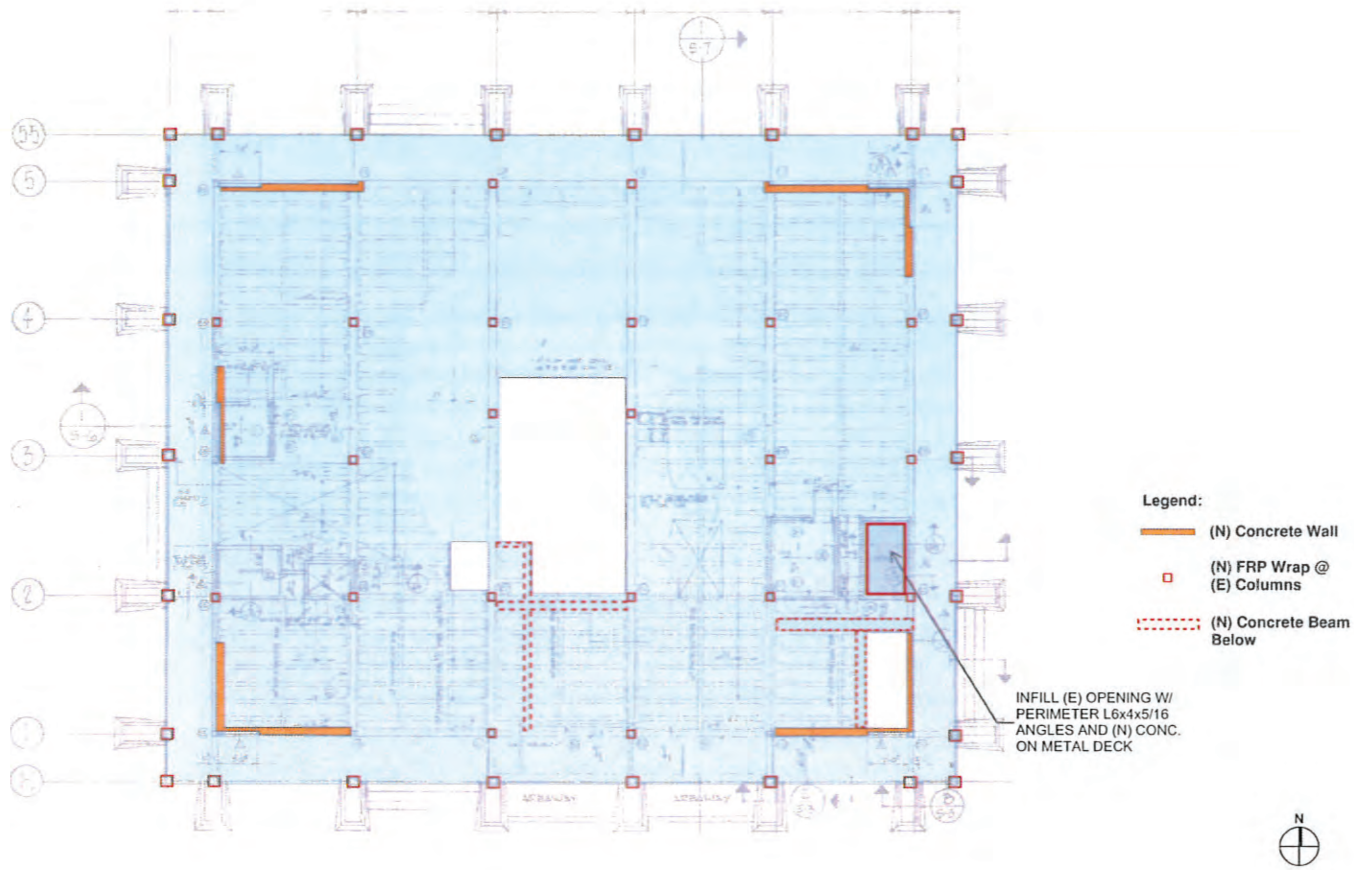
510 549-1906 510 549-1912 fax

Cupertino City Hall | Option C - Light Court
Cupertino, CA

TM Project: 2014,094 Scale: As Noted

Terrace Level Plan
September 29 2014

S0



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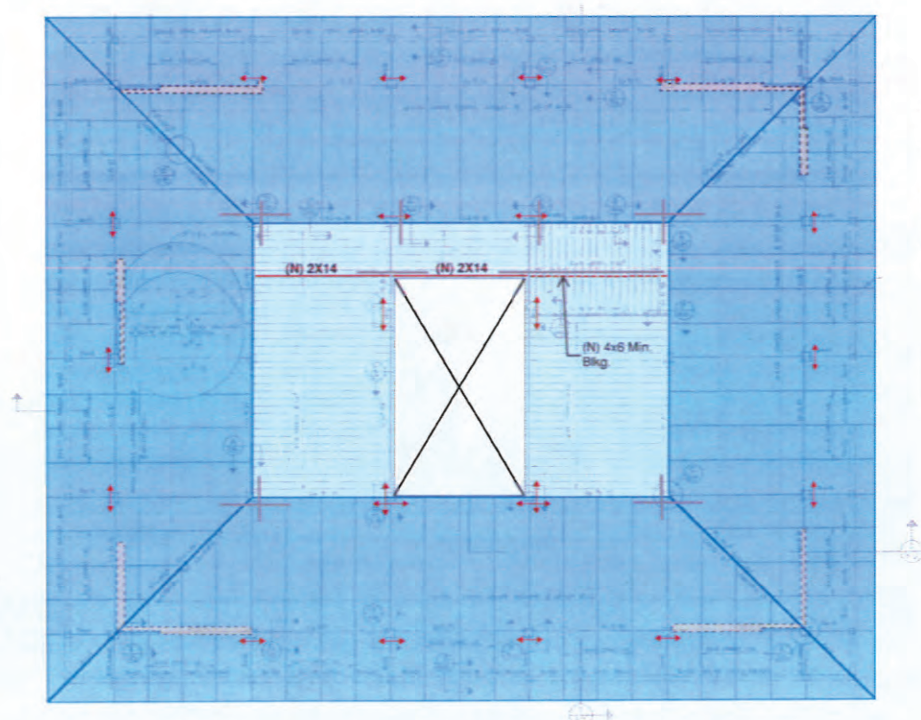
510 549-1906 510 549-1912 fax

Cupertino City Hall | Option C - Light Court
Cupertino, CA
TM Project: 2014,094 Scale: As Noted

Ground Floor Plan
September 29 2014
S1



Legend:

(N) Concrete Wall Below

(N) High Load Diaphragm
Provide (N) 3/4" Plywood over (E) 1/2" Plywood and 3X T&G Blocking w/ 2 Rows of 10d Nails @ 2 1/2" o.c. along diaphragm boundaries and cont. panel edges, 4" o.c. at other panel edges, and 12" o.c. in field

(E) Reinforced Diaphragm
Reinforce (E) 1/2" Plywood w/ 1 Row of 10d Nails @ 2" o.c. along diaphragm boundaries and cont. panel edges, 3" o.c. at other panel edges, and 12" o.c. in field. Provide (N) 4x6 min. blocking @ cont. panel edges perpendicular to framing direction, typ.

(N) Simpson CMST strap or Simpson Holdown

Retrofitted WF Steel Collector Connection

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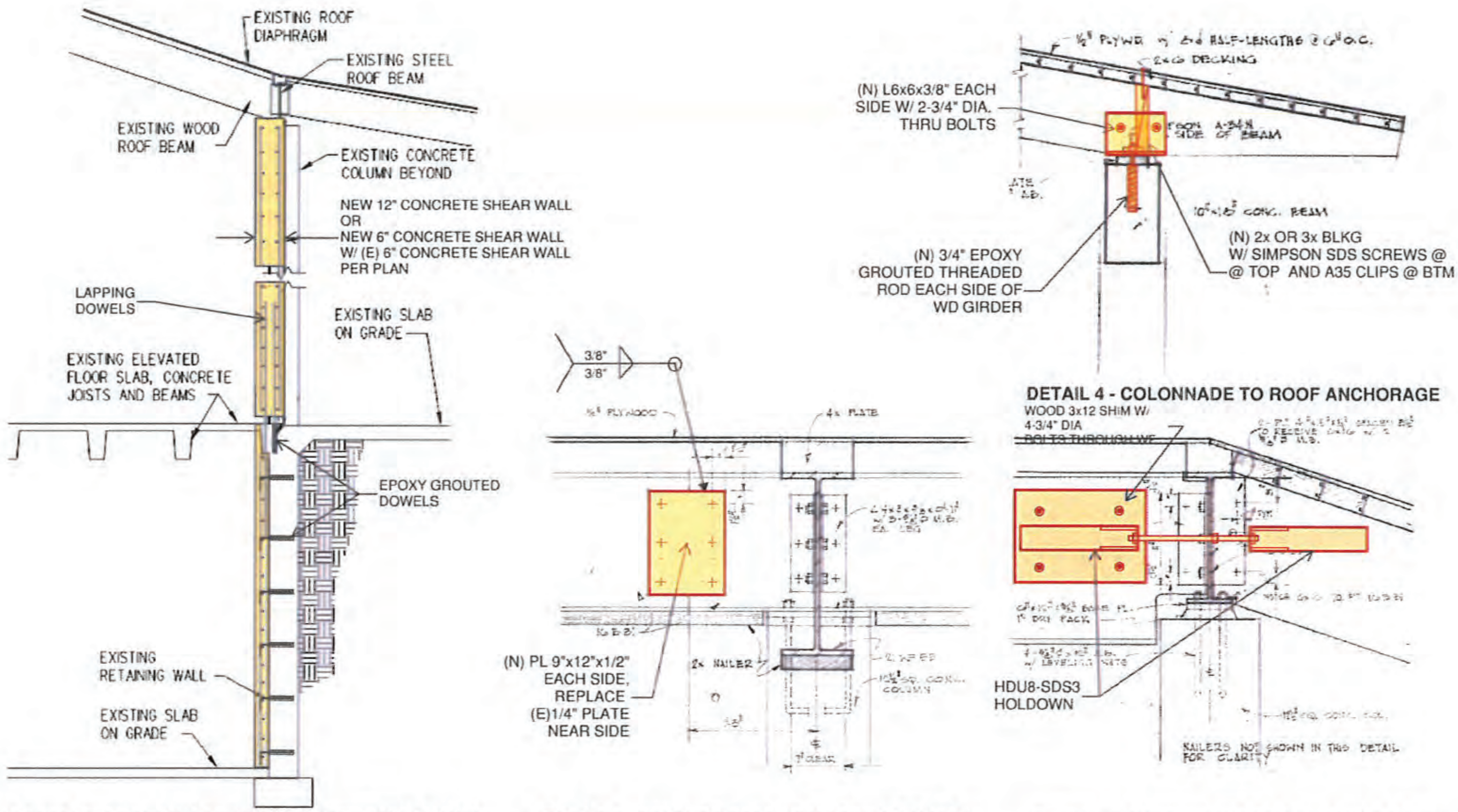
Cupertino City Hall | Option C - Light Court
Cupertino, CA
TM Project: 2014,094 Scale: As Noted

Roof Plan
September 29 2014
S2



DETAIL 3 - SECTION AT NEW CONCRETE SHEAR WALL

DETAIL 2 - STEEL TO STEEL COLLECTOR SPLICE

DETAIL 1 - STEEL TO WOOD COLLECTOR CONN.

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Cupertino, CA
TM Project: 2014,094 Scale: As Noted

Retrofit Details
September 29 2014
S3

The following document was provided by the City of Cupertino. The structural evaluation was prepared by AKH Structural Engineers, Inc. for the City in November, 2011.

Report of Results from Structural Analysis and Evaluation of Existing Cupertino City Hall

Examining Structure's Compliance with 1985 Uniform Building Code as an Essential Facility

Prepared for

The City of Cupertino

November, 2011

Prepared by

AKH Structural Engineers, Inc.
Consulting Structural Engineers

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San Jose, California 95125
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Web: www.AKHSE.com

AKH Project No. M11-040

CONTENTS

Introduction

The original Cupertino City Hall building was designed by San Jose architect, Wilfred Blessing, in 1965. Mr. Blessing retained the firm of Kirk McFarland Engineers, Inc. (KME) to perform the structural engineering, in accordance with the 1964 Uniform Building Code. A building permit was issued on December 2, 1965 and construction by Pursely Construction Company of Sunnyvale was completed a year later on November 19, 1966, at a cost of $433,600. Notice of Completion was filed with the Santa Clara County Recorder's office on December 2, 1966.

Two employees of KME at the time were Dennis Ahearn and William (Bill) Knox. Bill Knox prepared a significant portion of the structural calculations for the building, and prepared and supervised the preparation of the structural drawings, from which the building was constructed.

In 1970, Dennis Ahearn left KME and opened his own engineering firm. In 1973, Bill Knox joined Dennis Ahearn's firm as a partner, at which time the firm became Ahearn and Knox, Inc. In 1983, Tim Hyde joined the firm, later to become a partner in 1993, after which, the firm's name became Ahearn, Knox & Hyde, Inc. The firm is in business and practicing structural engineering in San Jose today, now known as AKH Structural Engineers, Inc. (AKH). All three partners are still active in the firm.

In 2005, the Cupertino City Architect, Terry W. Greene, contacted Bill. Knox to investigate the feasibility of adding a second floor to the existing building, taking into account the 1986 remodel and structural upgrades provided by the architectural firm of Holland, East & Duvivier (HED), with Cygna Consulting Engineers of San Jose, as the structural engineer of record. The 1986 upgrade had been undertaken to qualify as an Essential Facility, meeting the requirements for such in the 1985 Uniform Building Code, to allow for the inclusion of an Emergency Operations Center to be constructed in the then-unused basement.

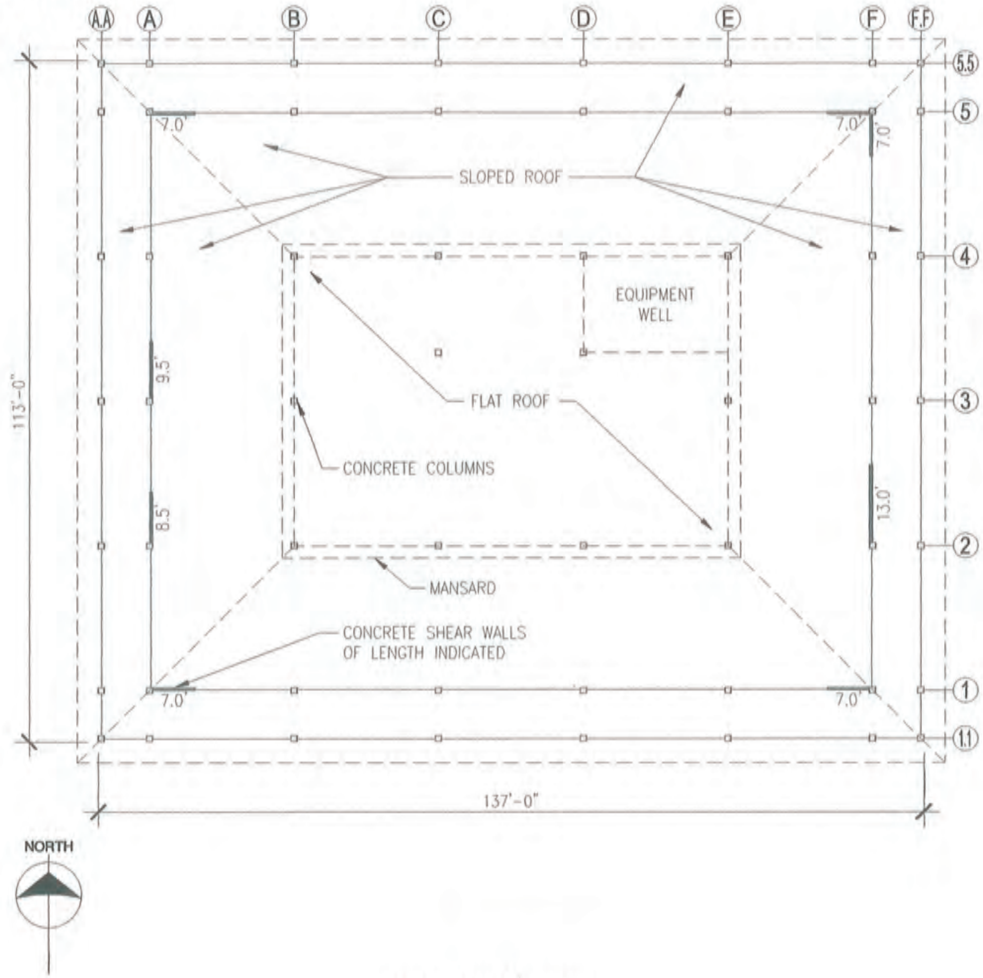
Mr. Greene sought out Mr. Knox for his structural expertise through the architectural firm of Sugimura & Associates Architects, located in Campbell, California, not knowing that Mr. Knox had been directly involved in the design of the original building. After learning of Mr. Knox's involvement in the original design, his continued review of the 1986 remodel was deemed very valuable. Bill Knox prepared a report of the City Hall building's seismic capacity on April 6, 2006 and delivered it to Gene Sugimura who then provided it to Terry Greene at City Hall.

Mr. Greene received a preliminary report from Bill Knox in November of 2005, which became the basis for a staff report by Mr. Greene to the Director of Public Works in December of 2005. Mr. Knox later produced a re-cap of the report, in April of 2006 and transmitted that re-cap to Gene Sugimura. Mr. Sugimura then transmitted the re-cap with calculations, to Mr. Greene on April 6, 2006.

Between April 2006 and July 2011, the City of Cupertino did not act on the recommendations in Mr. Knox's report. In June of 2011, the City approved a Civic Center Master Plan project for the FY 2011/2012 CIP. Mr. Greene subsequently contacted Tim Hyde of AKH to provide a new, comprehensive review of the City Hall building's seismic capacity, especially with regard to the compliance with the 1985 Uniform Building Code, as required for an Essential Facility.

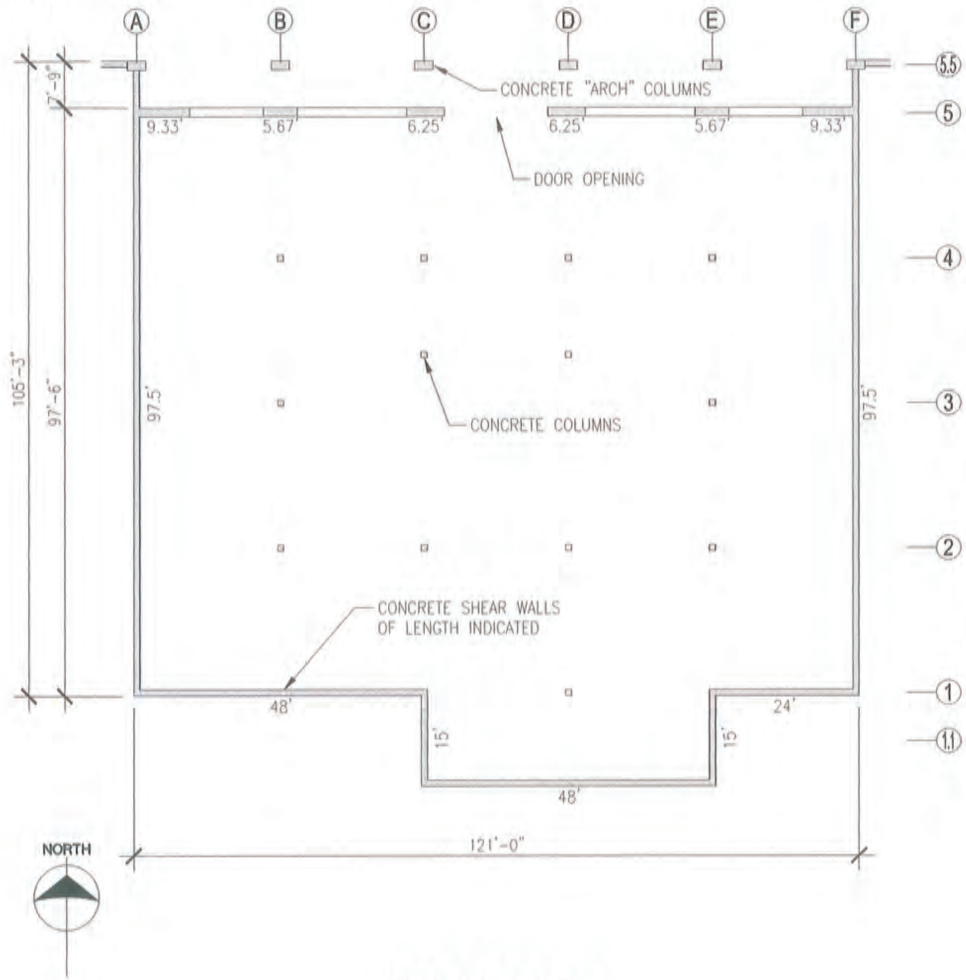
Results and findings from the recent, 2011 analysis follow below. The analysis includes the review of construction data that was not utilized in the 2005 review.

Upper Level:



(Note: Not to scale)

Lower Level:



(Note: Not to scale)

Seismic Analysis - Approach and Applied Concepts

Original Design Engineer's Project File:

As indicated above, Bill Knox and Dennis Ahearn were former employees of Kirk McFarland Engineers, Inc., the Structural Engineering firm that performed the original design of the City Hall building in 1965. Fortunately, KFE's project file for the building's original design was given to Bill Knox and Dennis Ahearn several years ago. Thus, we have some original calculations, testing results, shop drawings and other miscellaneous written correspondence for the project's original design and construction. As part of the project file, we also have the original structural drawings, dated 1965.

We have been able to utilize these documents, including the calculations and shop drawings, to help determine and confirm certain properties of the building, such as material weights and original design assumptions and loading.

Documents for the 1986 Building Alterations:

We are in possession of the structural drawings and calculations prepared at that time by Cygna Consulting Engineers, and have referenced these documents when necessary to confirm certain conditions and design intent.

Structural Modeling:

For our analysis, the Cupertino City Hall structure was modeled in the ETABS computer program, which is a Finite Element Analysis (FEA) application. The model was utilized to determine the seismic forces distributed to the concrete shear wall elements above and below the grade-level floor slab. The use of the FEA program is not inconsistent with the design requirements in the 1985 Uniform Building Code. The program allows for more accurate modeling of the various wall elements, especially those with openings along grid lines 5 and 5.5.

As the wood-framed roof is considered a "flexible diaphragm," the lateral seismic forces at the Upper Level were determined outside of the ETABS program by separate calculation, based on tributary areas to the wall lines. Those forces were then applied to the lines of shear walls in the ETABS model. ETABS distributes those forces to the walls along each wall-line according to the walls' relative rigidities. As steel beams occur along the wall lines, act as collectors/drag struts and connect all of the walls together, this assumption is accurate.

The Lower Level seismic forces were applied to the ETABS model at the grade-level slab, and the total of all forces were then distributed to the all of the Lower Level concrete shear walls, based on their relative rigidities, resulting from direct forces and accidental torsion forces, as required by the 1985 UBC for rigid diaphragm structures.

The walls along grid lines 5 and 5.5 were modeled to reflect their actual configurations, with regard to openings, thicknesses and support conditions.

Building Codes:

The scope of this evaluation includes assessing the structure using seismic forces required in the 1985 Uniform Building Code (UBC), as this was the Code to which the 1986 alterations were designed. As we know, the Building Code has evolved and undergone numerous revisions since that time. As requested, this report presents the results of our analysis with respect to the 1985 UBC. However, in order to provide an overall comparison, the primary force levels required in the 1985 UBC will be compared to the analogous forces required in the current, 2010 California Building Code (CBC).

Seismic Force Levels:

Simply, the lateral seismic force, or Base Shear, for which a building is designed, is merely a percentage or fraction of the building's weight. That percentage is determined by several factors, including (a) the seismic zone in which the building is located, (b) the geologic conditions and soil types present at the site, (c) the building's structural systems that resist the seismic forces, and (d), the intended of use or occupancy of the building. Essential Facilities have occupancies that affect this portion of the Base Shear equation.

Essential Facilities and Seismic Importance Factors:

Essential Facilities are those that must remain operational for emergency purposes, such as after a major earthquake or other disaster. These structures would be designed to resist higher seismic forces and are reflected in the Importance Factor, which is applied to the overall Base Shear force. The Importance factor for most residential and commercial buildings is 1.0. The Importance Factor for Essential Facilities is typically higher than 1.0.

From the 1976 UBC to the 1985 UBC, the Importance Factor for an Essential Facility was 1.5. In the following, 1988 UBC, **the Importance Factor was reduced from 1.5 to 1.25,** effectively reducing the seismic forces for which this type of Essential Facility would be designed, as compared to the previous 1985 UBC. The Importance Factor for Essential Facilities remained 1.25 for the primary elements in the seismic-force-resisting systems, until the 2007 CBC when it changed back to 1.5 and remains as such in the present 2010 CBC.

Existing Concrete Strengths:

The McFarland project file contains numerous concrete compression test results for the various concrete elements in the building, at both the upper and lower levels. The minimum design compressive strength for the structural walls was specified to be 3,000 psi. All of the test results for the wall concrete indicate that the lowest compressive strength at 28 days is 3,490 psi, with the mean value being over 4,620 psi. Based on these results, we have used a concrete strength of 3,500 psi throughout our analysis. Where deficient conditions are found to exist, they were based on this concrete strength. The yield strength used for the reinforcing was 40 ksi. This value is confirmed by test results for the reinforcing found in the original project file.

Comparison of Required Seismic Design Forces in 1964, 1985 & 2010 Building Codes:

1964 Uniform Building Code:

Force levels expressed at Allowable Stress Design (ASD) levels.
W = Weight of structure.
Upper Level: F_{EQ} = 0.133 x W = **0.13 x W at Upper Level**
Lower Level considered subterranean and not included in seismic design.

1985 Uniform Building Code:

Force levels expressed at Allowable Stress Design (ASD) levels.
Building designed as an **Essential Facility**; Importance Factor, I = 1.5.
Upper Level: F_{EQ} = 0.14 x 1.5 x W = **0.21 x W at Upper Level**
Lower Level: F_{EQ} = 0.19 x 1.5 x W = **0.28 x W at Lower Level**

2010 California Building Code, which References ASCE7-05:

Force levels expressed at Allowable Stress Design (ASD) levels.
Redundancy factors of 1.3 for Upper Level and 1.0 for Lower Level are included.
Essential Facility, reflected in Occupancy Type and Structural Design Categories.
Upper Level: FEQ = 0.21 x 1.3 x W = **0.27 x W at Upper Level**
Lower Level: FEQ = 0.27 x 1.0 x W = **0.27 x W at Upper Level**

Comparing Base Shear force magnitudes for 2010 CBC over 1985 UBC:
For the Lower Level, there is no increase in applied seismic force

Varying Lateral Force-Resisting System Types:

The 1988 UBC, issued immediately subsequent to the 1985 Code, included certain provisions for the vertical distribution of seismic forces when the lateral force-resisting systems varied at each level. In this building, the upper-level shear walls do not support a significant portion of vertical load, whereas the shear walls at the Lower Level (Basement) do support significant vertical dead and live load. This difference results in different overall seismic factors for each level. The 1988 UBC and later Codes require that the seismic forces from the upper level be scaled up in proportion to the corresponding seismic factors when applied at the lower level. However, the 1985 UBC did NOT include these provisions. Thus, our analysis does not include these provisions, even though the approach required in the current Code would require this more-conservative scaling of forces.

Vertical Re-Distribution of Seismic Forces:

The Building Code requires that a building's seismic forces be distributed over its height, based on a weighted average of each level's combined weight and height above the base. This is a generally accepted means of accounting for the momentum generated by the upper levels moving in an earthquake, perceived as a "whipping" action.

For structures that have levels substantially below adjacent grade, those subterranean levels are not included in the vertical re-distribution as their lateral deflections are dampened by the surrounding earth. In addition, the subterranean portions are typically much more rigid laterally than the superstructures above. For these reasons, such a building's base is considered to be at grade level for the purpose of vertical force re-distribution.

The 1986 alterations to the subject building exposed one full side of the structure that had previously been below adjacent grade. One could argue that the building's lower level should subsequently NOT be considered subterranean, and that the structure's lower level should be included in the vertical distribution of forces.

The stiffness of the lower level, with long shear walls, is substantially higher than the upper level, which has relatively short shear walls and a lower overall stiffness by inspection. In addition, for the most critical wall along grid line 5, which was exposed by excavation and received multiple openings in the 1986 alterations, would receive lateral, in-plane seismic forces when the lateral, seismic forces are acting on and perpendicular to the sides that remain below adjacent grade, moderating the lateral drift and the forces reaching the wall on line 5. Also, seismic forces acting perpendicular to the wall on grid line 5 would be resisted by the long, rigid shear walls at lines A and F, and would not be resisted by the altered wall on grid line 5.

For these reasons, the subterranean, lower level is not included in the re-distribution of lateral seismic forces. A review of Cygna's calculations confirms that this was the same methodology used in their analysis, performed in 1986.

Apparent Errors Found in 1986 Analysis and Design:

The design calculations for the 1986 alterations utilized incorrect tributary areas and/or unit-weights to determine tributary building masses, resulting in calculated masses at both the Upper and Lower levels that were significantly less than represented by the actual conditions. These masses relate directly to the seismic forces for which the building was designed to resist, including the shear walls and the diaphragms.

For example, the effective areas of roof that include the heavy roof tiles were significantly less than the actual areas tributary to each shear wall line. In addition, the six-foot-high parapet, which also supported the heavy roof tiles, was ignored completely in the determination of the building mass at the Upper Level. Also, at both levels, the masses of the concrete walls perpendicular to the direction of seismic force in consideration were not included in the effective building mass.

The 1986 analysis incorrectly calculated the respective masses as follows:

- Upper Level: Underestimated mass by 45% to 59%, depending on direction considered
- Lower Level: Underestimated mass by 24% in either direction considered
- With respect to the overall building, the underestimates amount to approximately 34%.

Analysis of Existing Concrete Floor Girders

Determination of Possible Causes of Visible Cracks:

Some narrow cracks are apparent in the existing cast-in-place concrete floor girders at grade level, over the basement. None of the visible cracks are of widths that are considered significant with respect to the members' ability to resist the supported loading.

We have analyzed the subject girders as well as the smaller concrete joists that are supported by the girders.

It should be noted that reinforced concrete members MUST crack in order to facilitate load transfer to the steel reinforcing, and for the steel reinforcing to provide the resistance to applied loads as designed. Typically, the cracking that occurs is spread throughout the concrete members, and thus, the cracks are smaller than what can be observed visually. In other cases, certain conditions can cause a concentration of strain and the resulting release of stress causes visible cracks. However, visible cracks, in of themselves, are not necessarily indicative of overstressed or deficient conditions.

Our analysis considered the required loading and design concepts in both the 1964 UBC, with regard to the original design of these members, and with regard to the current 2010 CBC, in order to ascertain any possible design criteria or other considerations that exist in the current Code, but that might not have been accounted for over 40 years ago.

There have been some minor revisions over time in the Code-required vertical loads for which these floor members would be designed. These include uniform loading for things such as partitions, live loads for certain occupancies and uses, and live load reductions allowed based on tributary areas being supported by the respective members. In general, the design loading in exit facilities, such as corridors and lobbies, have remained constant at 100psf. Live loads for office areas have also remained constant at 50 psf. Live loads in assembly areas with fixed seating have increased from 50 psf in the 1964 UBC to 60 psf in the 2010 CBC. Finally, the 1964 UBC did not require loading for movable partitions, where the current 2010 CBC requires a uniform load of 15 psf live load for moveable partitions. However, as was common at the time, the design of these members did include partition loading of 20 psf overall office areas.

There have also been significant revisions in the analysis and design of concrete members since the 1964 UBC. The subject concrete members have been examined in terms of the design concepts used in the 1964 Code, as well those used as the 2010 CBC, in order to determine what conditions, theoretically and practically, might be the cause of the cracks.

Concrete Joists:

The analysis of the concrete joists indicated that their capacities in shear and flexure are adequate for all loading conditions, in accordance with the 1964 and 2010 Codes.

Concrete Girders:

The girders were analyzed closely, with the appropriate magnitudes of loading applied as accurately as possible. All four lines of girders have been analyzed. In all cases, the girders have been found to be adequate to resist the calculated flexural moments (bending forces).

With regard to vertical shear in the girders, our analysis considering the 1964 UBC indicates that the amount and/or spacing of the shear reinforcing (stirrups) is adequate in all locations.

However, the intent here is to identify possible causes for the apparent cracks. Thus, we also analyzed the member shear according to the 2010 CBC requirements. In that case, our calculations indicate that the amount and/or spacing of the shear reinforcing (stirrups) is inadequate in certain locations. However, closer inspection of the Code requirements indicate that the shear reinforcing is adequate in the majority of cases, when based only on the actual shear stresses in the members.

Certain prescriptive requirements exist in the current CBC that were not included in the 1964 UBC. These requirements specify a minimum amount of steel shear reinforcing (ties or stirrups), which is based on the maximum stirrup spacing, and is dependent primarily on the members' cross-sectional areas, without regard to actual shear forces or internal stresses.

The magnitudes of girder shear are typically the highest near the supporting columns. Of the four north-south floor girders, according to the 2010 CBC analysis, the areas with excessive stirrup spacing occur along one girder on grid line C, which has a longer interior span between supporting columns, and supports areas of higher live load than the other girders. The three other girders also have some areas of excessive stirrup spacing based on the prescriptive requirements, but they are limited to areas immediately close to the columns.

Total shear resistance in concrete members is provided by two primary components. The first is the concrete itself, where the shear capacity is based on the concrete strength and the member's cross-sectional properties. The second component is the steel shear reinforcing (stirrups). The amount of reinforcing provided can be affected by the size of the bars used in the stirrups, and the spacing of those stirrups along the member's length. These two components combine to provide the total shear resistance, or shear capacity.

In some locations, typically at the ends of the longer girder spans, the spacing of the shear stirrups in the girders is excessive where based on the actual, calculated shear capacity needed in the girder. It should be noted that this is a calculated deficiency only when the applied loading represents the full live load over the majority of the member's tributary area. In the locations where the calculated shear demand exceeds the capacity, the girder is overstressed in shear by up to 21% in areas near two of the supporting columns. The overstress results from the shear stirrups being spaced too far apart in order to provide the necessary total shear capacity. In these subject areas, the spacing of the stirrups is approximately two-times the spacing needed to provide an adequate total shear capacity to meet the demand.

Possible Causes of Cracking:

Based on our close examination of the joists and girders, and the calculated flexural and shear stresses within the members, we have determined that the locations of the apparent cracks do NOT correlate with areas of higher flexural or shear stresses. Rather than resulting from overstress conditions, it is our belief that the observed cracking has likely resulted from one or more of the following long-term causes:

1. Soil consolidation and resulting settlement of the foundations below columns
2. Changes in moisture content in expansive soils below the foundations
3. Shrinkage of the concrete due to curing over time
4. Elastic, long-term deformation of the concrete, known as creep
5. Concentrations or build-up of internal stresses being released by the numerous minor and moderate seismic events that the structure has experienced over its lifetime.

Summary of Identified Structural Deficiencies

All deficiencies listed below are with regard to the 1985 Uniform Building Code, unless indicated otherwise.

Deficiencies Due to Calculated Capacities:

These deficiencies have resulted from calculation that determined the capacities of the respective elements are less than the demand or applied designs forces.

A. Upper Level Concrete Shear Walls:

1. On Grid Lines 1 and 5: These walls are overstressed in **in-plane bending**, as much as 144%, meaning that the demand is approximately 2.44 times the capacity.

2. On Grid Lines A and F: These walls are overstressed in in-plane bending, as much as 150%, meaning that the demand is approximately 1.5 times the capacity.

All Upper Level Shear Walls on All Grid Lines:

3. Based on the calculated compressive stress, the walls require Boundary Members at ends of shear walls. Boundary members are column-like elements with added vertical reinforcement and closely-spaced lateral ties that resist the high compressive forces induced by overturning demands in highly-loaded shear walls. At the ends of these walls not adjacent to a concrete column, no Boundary Members exist. This cannot be expressed as a magnitude of overstress, as the Code requirement is prescriptive. The magnitude of overturning forces in these shear walls requires Boundary Elements, but none are provided.

4. Based on the calculated shear stress, these walls require two curtains of reinforcing due to magnitude of in-plane shear stress. Only one curtain of reinforcing is provided in these 6" thick walls. This cannot be expressed as a magnitude of overstress, as the Code requirement is prescriptive. The magnitude of shear stress requires two curtains of reinforcing, but only one layer is provided.

5. Anchor bolt connections for transferring in-plane seismic shear forces at top of walls are overstressed as much as 26%, meaning that the demand is approximately 1.26 times the capacity.

B. Lower Level Concrete Shear Walls – No Deficiencies. Comments only:

Shear Walls Along Gridlines 5 & 5.5. There appear to be no overstress conditions in the overall shear walls throughout the building, or in the individual shear wall elements on grid lines 5 and 5.5. The added reinforcing within the 6-inch-thick shotcrete added to the remaining wall segments on line 5 in 1986 allows these elements to satisfy the applicable Code requirements. It should be noted that the added columns, as parts of the arches constructed along grid line 5.5 actually resist relatively low forces, and are adequate for the forces acting on them. **No deficiencies identified.**

C. Roof Diaphragm Shears:

Currently, the calculated roof diaphragm shears exceed the shear capacity of the plywood sheathing significantly. The 1/2-inch thick plywood, with nailing as specified on the original drawings, has an allowable shear capacity of 325 plf. The calculated diaphragm shear is as high as 898 plf in the north-south direction, and 690 plf in the east-west direction, resulting in the demand being 2.76 and 2.12 times its capacity, respectively. This represents overstresses of 176% and 112%, respectively.

It should be noted that the drawings do not indicate that Structural I plywood was used, however, reference to Structural I plywood was made in some of the 1986 calculations performed by Cygna Engineers. If Structural I plywood were used, the allowable shear would be 360 plf, however, the overstress conditions would still be significant.

The plywood sheathing lies directly over 3x decking at the sloped areas of roof, which acts as "blocking" at the adjacent panel edges. Generally, this type of decking can also be assumed to resist 100 plf to 300 plf in diaphragm shear, depending on its orientation and nailing. However, even if a 300 plf value is added to the allowable plywood shear value, the roof diaphragm shears still exceed the combined capacity significantly near the diaphragm perimeter, and extending significantly inward toward the center of the building.

D. Diaphragm Chord Connections at Roof:

The connections between the steel beams near the roof's perimeter are overstressed approximately 35% in resisting the highest chord forces, which occur at the middle of the diaphragm. The calculated connection capacities account for the steel shear plates that were added as part of the 1986 alterations. The same connections are adequate to resist the critical collector drag forces, which occur nearest the ends of the concrete shear walls at the Upper Level.

Deficiencies Due to Prescriptive Code Requirements:

The two aspects of the building's design below are part of the original 1964 design and were likely in compliance with the Building Code at that time, but they do not comply with newer requirements in the 1985 UBC. In general, these issues do not necessarily relate to stresses or force-levels, but address prescriptive Code requirements, and thus, a graduated level of compliance cannot be indicated.

E. Concrete Column Ties:

The #2 (1/4"ϕ.) ties around the concrete column vertical bars are inadequate in size and spacing, especially for the upper and lower 20% of the column height, where the actual spacing provided is generally two times, or 100% greater than allowed by the 1985 UBC. Added, external confinement can be installed around existing columns such as these, but no such reinforcing exists.

F. Concrete Column Ties at Top:

The 1985 Code, in this seismic zone, requires that several added, closely-spaced ties be provided at the tops of columns surrounding embedded anchor bolts, but no such ties were provided in the original columns. Added, external confinement can be installed around existing columns such as these, but no such reinforcing exists.

Potential Means to Mitigate Noted Deficiencies

Referencing pages 10 through 11 above, possible means for mitigation of the identified deficiencies are as follows:

Concrete Shear Walls:

A.1 and **A.2 – Shear Wall In-Plane Bending:**

The deficient bending capacities would typically be addressed by adding steel reinforcing at the extreme ends of the walls, which could resist more net tension induced by in-plane overturning or flexure in the shear walls. This could entail structural steel shapes fastened to the subject walls and extended down to the lower walls, or could include reinforcing added inside new concrete "column" elements, such as with shotcrete. Other methods could include thickening the walls over their lengths, partially or entirely, in order to reduce the tension demand at the wall ends. This could also be provided using shotcrete.

A.3 – Shear Wall Boundary Members:

New Boundary Members could include newly-applied concrete at the ends of the walls, and/or new steel members on the outside of the walls at the ends to provide the necessary stability under compressive loads induced by overturning.

A.4 – Second Layer of Wall reinforcing:

Providing a second curtain of wall reinforcing would require thickening the concrete walls, likely with applied shotcrete, and new reinforcing bars within.

A.5 – Anchor Bolt Connections at Top of Shear Walls:

New anchor bolts could be installed at the top of the walls directly through the existing beam flanges, or through added steel plates or angles welded to the steel beams.

B: Not a deficiency.

C – Roof Diaphragm Shears:

If the heavy Spanish tile roofing were to be replaced with composite asphalt roof tiles over its entirety, on the parapets and sloped roof areas, the correlating seismic force at the Upper Level, and overall, would be reduced significantly. The dead load occurring at the roof alone would be reduced by approximately 33%. This would also significantly reduce the total seismic force acting on the structure at the Lower Level as well. Although the roof diaphragm would still be overstressed in resisting Code-required seismic loading in smaller areas, the effects of using lighter roofing would be significant, and would likely greatly improve the building's performance and level of protection during a moderate or major earthquake.

As the capacity of the plywood roof diaphragm is dependent on the nailing of the plywood along the adjoining panel edges, the diaphragm capacity could be increased significantly with the addition of new nailing between the existing nails. Of course, access to the sheathing would be required. Thus, this method of strengthening the roof diaphragm could only be provided in conjunction with the removal of the existing roofing. As mentioned above, replacing the heavy, existing Spanish tile roofing with lighter roof tiles could yield

significant benefits in reducing the building mass and the resulting seismic forces on the structure. The combined effect of adding nailing to the existing plywood sheathing during the course of replacing the heavy tile roofing with lighter roof is obvious. Using reasonable assumptions as to weight of replacement roofing and maximum amount of added nailing in certain locations, the roof diaphragm shear capacities could be brought to within approximately 90% of the demand, reducing the overstress levels to approximately 11%.

D. - Diaphragm Chord Connections at Roof:

The subject connections could be strengthened with the addition of welding around the plates to the beam webs. This strengthening would be required in only limited places, near the middle of the building along each perimeter beam line, as the chord forces are the highest in the middle of the roof diaphragm, along the chords' lengths.

E. – Concrete Column Ties:

The columns' confinement could be increased through the use of external, surrounding "jackets." These could be of steel, concrete (shotcrete) or carbon fiber. The most cost-efficient and practicable method would likely be using carbon fiber layers applied with resin around each column for its entire height. This would have the least spatial effect, and would not increase the mass of the columns.

F. - Concrete Column Ties at Top:

As this aspect is similar to the deficiency noted immediately above, but more specific to location, means provided above to mitigate this issue would likely be the same. In fact, in the process of addressing the item above, this issue would be addressed and resolved as well.

End of Deficiency Mitigation

Possible Non-Compliance with Current 2010 Building Code

Editions of the Uniform Building Code since 1985, and more recently, the California Building Codes, have addressed **redundancy** and **ductility** in modern buildings' seismic-force-resisting systems. The design force equations in the newer Codes have undergone substantial revisions to more accurately reflect the various types of structural systems used, as well as the probability of major seismic events based on the fault types. However, the most significant revisions to recent seismic design requirements have been focused on ensuring better system performance in terms of the stability and ductility of members, especially when subjected to forces that are beyond the members' elastic range, or when elements undergo partial or complete failure.

At least six Building Code editions have been issued since the 1985 Uniform Building Code was published. Evaluating compliance of the Cupertino City Hall with respect to the most recent of these codes is beyond the scope of this analysis. However, it is expected that certain structural aspects of this building would be found not to comply with particular requirements in the current Code. And just as several aspects of the building have been found not to comply with the 1985 UBC, it is expected that more aspects would be found not to comply with the newer requirements in the most recent 2010 California Building Code.

Summary of Applied Seismic Design Forces

Comparative Seismic Force Factors for 1964 UBC, 1985 UBC and 2010 CBC:

W = Building Weight

According to 1964 Uniform Building Code:

Upper Level: F_{EQ} = 0.133 x W = **0.13 x W at Upper Level**
Lower Level considered a subterranean basement and not included in seismic design.
Essential Facilities not considered in 1964 UBC

According to 1985 UBC, as Essential Facility

Upper Level: F_{EQ} = 0.14 x 1.5 x W = **0.21 x W at Upper Level**
Lower Level: F_{EQ} = 0.19 x 1.5 x W = **0.28 x W at Lower Level**

According to 2010 CBC & ASCE7-05, as Essential Facility:

Upper Level: F_{EQ} = 0.21 x 1.3 x W = **0.27 x W at Upper Level**
Lower Level: F_{EQ} = 0.27 x 1.0 x W = **0.27 x W at Upper Level**

The 1.3 factor at Upper Level is the required Redundancy Factor.
Comparing Base Shear force magnitudes for 2010 CBC over 1985 UBC:
For Upper Level, there is a **30% Increase** in applied seismic force over 1985 UBC levels
For Lower Level, there is no increase in applied seismic force

Comparing Base Shear force magnitudes for 2010 CBC over 1964 UBC:
For Upper Level, there is a **108% Increase** in applied seismic force from 1964 UBC levels.
For Lower Level, the structure was considered a basement therefore no comparison is made.

End of Report

Page 14 of 14

The following document was provided by the City of Cupertino. The seismic report was prepared by Sugimura & Associates Architects and AKH, Inc.

Sugimura & Associates
Architects

Architecture • Planning • Interiors
Landscape Architecture

Document1

Letter of Transmittal

Date: April 06, 2006 **Project Number:** 2506

To: **Terry Greene, A.I.A.**

Address: Public Works Dept
City of Cupertino
10300 Torre Avenue
Cupertino, CA 95014-3255

Attention:

Subject: T.I. & Seismic Project for the City Hall Building

Please find enclosed the following:

Date	Quantity	Description
April 6,'06	one page	"Recap" Cover Letter
~~11-6-05~~ 4.5.06	13 pages	Structural Calculations for Civic Center
Dec ~~6~~ 7, '05	one page	Research on what the CYGNA calculations show & what was assumed for loading, etc.
Nov ~~8~~ 10, '05	~~two~~ three pages	Report of Analysis of the existing building with reference to the current Code, the '01 CBC, and its shear protection.

Note: this is being provided in support of the current invoice submitted by our Structural Engineer, Ahern-Knox & Hyde, Inc.

For your: review and files

The above items are being submitted and delivered by G. Sugimura on 4/06/06.

By: G. M. Sugimura, A.I.A.
Senior Principal

2155 So. Bascom Ave., Suite 200
Campbell, CA 95008
408 / 879-0600 Fax 408 / 377-6066

E-mail: SAA@sugimura.com
Website: www.sugimura.com

Principals
Gene M. Sugimura, AIA
Reed C. Grandy, ASIC
Christopher B. Clancy, AIA

Associates
Susan M. Landry, ASLA
Mirella Sion, Assoc. AIA

akh AHEARN, KNOX & HYDE, INC.
Structural Engineers

Dennis B. Ahearn, S.E.
William S. Knox, S.E.
Tim D. Hyde, S.E.

April 6, 2006

Sugimura & Associates Architects
2155 S. Bascom Avenue, Suite 200
Campbell, CA 95008

Att: Gene Sugimura
Ref: Cupertino City Civic Center Remodel

Dear Gene;

This is a recap of the work our office has performed on this project.

1. Preliminary analysis and framing scheme for the first design presented to us. This was the design that changed the shape of the existing roof to match the adjacent City Hall. This took considerable time for which we received no reimbursement.
2. Seismic analysis of the existing building for conformance to the 2001 California Building Code. After this analysis was completed we were informed that the facility is considered to be an Essential Facility due to the Emergency Operations Center being located in the building. This requirement increased the seismic forces that the structure is required to resist by 25% and our analysis had to be redone. In my letter to you of 11-8-05, I indicated several areas of overstress that would need to be addressed in the remodel to conform to the current code.
3. We were provided with a copy of the structural calculations that CYGNA compiled for the modifications to the building in 1986. We were asked to study these calculations to determine why CYGNA's conclusions differed from our analysis results. As indicated in my letter to you of 12-6-05, we found several errors in their analysis.
4. To date we have expended eighty-seven (87) hours on the above listed work. Although we feel that two weeks of time for the above analysis, meetings and presentation of our findings is entirely reasonable, I understand that there are limited funds available in your agreement with the City of Cupertino. I am therefore reducing our billing to a partial progress billing of forty (40) hours of time.

Please feel free to call me if you have any questions, or would like me to meet with you and the City.

Sincerely,

William S. Knox
Structural Engineer

Enclosures: Final structural analysis, previous letters referenced.

1505 Meridian Ave., Suite B, San Jose, CA 95125 • Phone (408) 978-1970 • Fax (408) 267-7919

Ahearn, Knox & Hyde, Inc.
Structural Engineers

1505 Meridian Avenue
San Jose, CA 95125
Phone (408) 978-1970
Fax (408) 267-7919

Structural Calculations
Cupertino City Civic Center

Project Number:	M05-036	Date:	11-6-05
Project Engineer:	Knox	Code:	2001 CBC
Seismic Zone:	4	Wind Zone:	70 mph
Checked By:		Date:	

REGISTERED PROFESSIONAL ENGINEER
WILLIAM S. KNOX
No. 1914
EXP. 6/30/05
STRUCTURAL
STATE OF CALIFORNIA

Original Signature Required
To Be Valid Seal

STRUCTURAL LOADS

ROOF TYPE #1: Existing Tile Roof Slope, in/ft.: 4

Material	Decking	Purlins	Beams	Seismic	
Tile Roofing	21.0	21.0	21.0	21.0	
Plywood	1.5	1.5	1.5	1.5	
3x Decking	8.0	8.0	8.0	8.0	
Insulation	0.5	0.5	0.5	0.5	
Fire Sprinklers		4.0	3.0	2.0	
Ceiling		2.5	2.5	2.5	
Purlins		4.0	4.0	4.0	
Beams			1.0	1.0	
Miscellaneous	5.0	4.0	4.0	2.0	
Sub-Total:	36.0	45.5	45.5	42.5	
Slope Factor	1.9	2.5	2.5	2.3	
TOTAL DEAD LOAD:	37.9	48.0	48.0	44.8	psf

ROOF TYPE #2: Existing Built-up Slope, in/ft.: 0.25

Material	Decking	Joist	Beams	Seismic	
Roofing	4.0	4.0	4.0	4.0	
Plywood	1.5	1.5	1.5	1.5	
Insulation	0.5	0.5	0.5	0.5	
Fire Sprinklers		4.0	3.0	2.0	
Joist		3.0	3.0	3.0	
HVAC Equipment		5.0	5.0	5.0	
Beams			2.0	2.0	
Miscellaneous	5.0	5.0	4.0	2.0	
Sub-Total:	11.0	23.0	23.0	20.0	
Slope Factor	0.0	0.0	0.0	0.0	
TOTAL DEAD LOAD:	11.0	23.0	23.0	20.0	psf

FLOOR TYPE #1:

Material	Slab	Joist	Beams	Seismic	
Flooring	1.0	1.0	1.0	1.0	
Concrete Slab, 3"	38.0	38.0	38.0	38.0	
Fire Sprinklers		4.0	3.0	2.0	
Ceiling		2.5	2.5	2.5	
Joist, 6"x12" @ 36"		29.0	29.0	29.0	
Beams			5.0	5.0	
Miscellaneous	5.0	5.0	4.0	2.0	
Sub-Total:	44.0	79.5	82.5	79.5	
Partitions		20.0	20.0	20.0	
TOTAL DEAD LOAD:	44.0	99.5	102.5	99.5	psf

WALL TYPE #1: Stud Wall w/ Gyp Board Each Side

Material	Weight	
Studs @ 16" o.c.	1.5	
Gypsum Board	5.0	
Miscellaneous	1.5	
TOTAL WEIGHT:	8.0	psf

WALL TYPE #2: Stud Wall w/ Gyp Board One Side & Plaster One Side

Material	Weight	
Studs @ 16" o.c.	1.5	
Gypsum Board	2.5	
Plywood	1.5	
Plaster	10.0	
Miscellaneous	1.5	
TOTAL WEIGHT:	17.0	psf

WALL TYPE #3: 6" Concrete 75 psf

LIVE LOADS: Floor

Office Areas	50	psf
Corridors & Lobbies	100	psf
Assembly, Open	100	psf

LIVE LOADS: Roof	0 - 200	201 - 600	> 600	sq. ft.
Slope <4:12	20	16	12	psf
Slope 4:12 to < 12:12	16	14	12	psf
Slope > 12:12	12	12	12	psf

SOILS DATA

Firm: Date:
Address:

Phone:

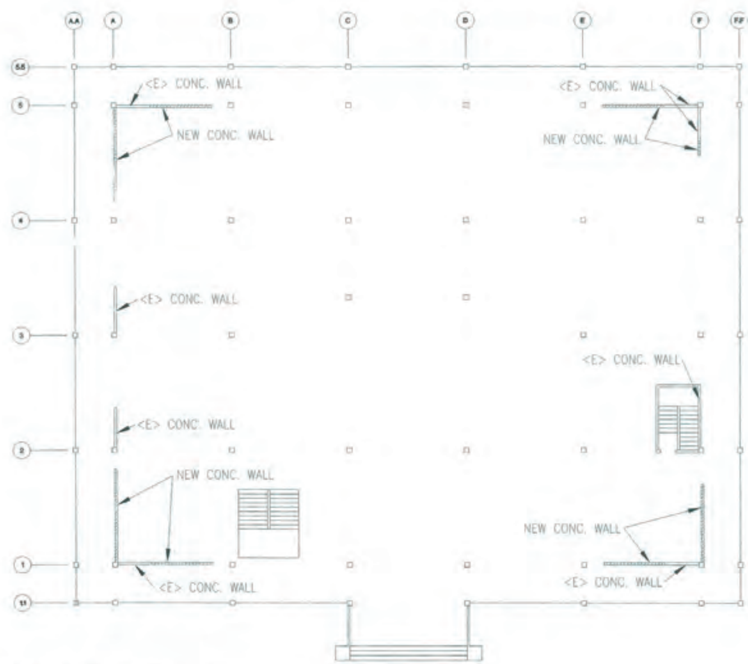
Recommendations:

Continuous & Spread Footings
Minimum Depth:
Minimum Width:
Dead Load Bearing:
Dead + Live Bearing:
Total Bearing:
Friction Coefficient:
Passive Pressure:

Pier & Grade Beams
Pier Friction:
Dead End Bearing:
Dead + Live Bearing:
Total End Bearing:
Disregard Top Depth:
Active on Footings:
Active of Piers:
Passive Pressure:

Cantilevered Retaining Walls
Active Pressure:
Passive Pressure:
Friction Coefficient:

Restrained Retaining Walls
Active Pressure:
Passive Pressure:



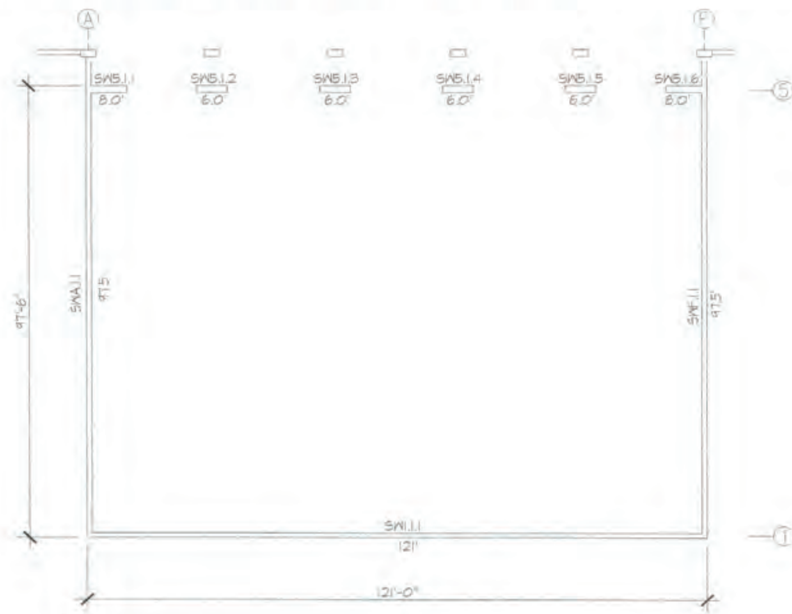
FLOOR PLAN – MAIN LEVEL

LATERAL ANALYSIS & DESIGN

L1

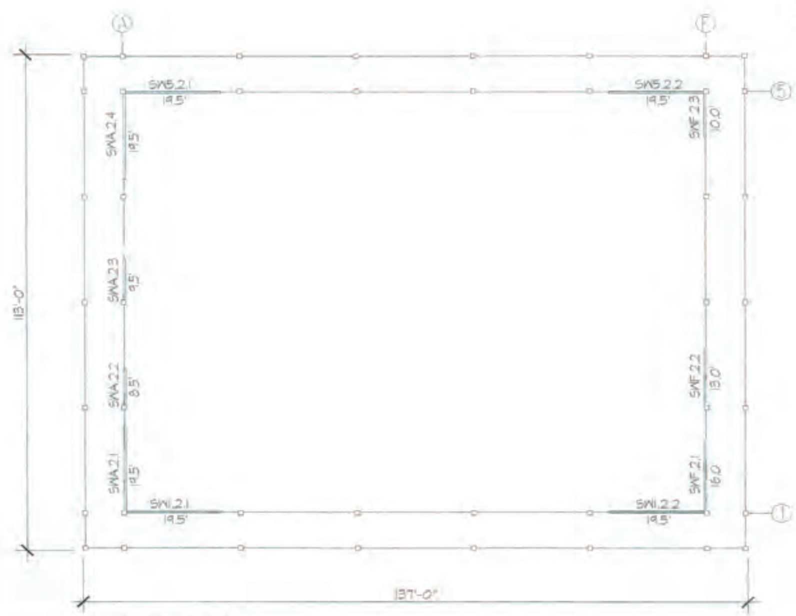
The upper level of the building lateral system consists of existing wood roof diaphragm and concrete shear walls. The lower level consists of a concrete joist floor system over concrete walls & columns. The lower portion was originally a full basement. In 1987 the North side of the building was excavated to the depth of the basement and the North basement wall opened up to a new patio. The building currently houses the City's Emergency Operations Center and is therefore an essential facility.

Earthquake Data:
Nearest fault is the Monte Vista - Shannon fault, 7 km. Distant. Type B fault



LOWER LEVEL PLAN

Calculations: Lateral
4/5/2006 Page 1



UPPER LEVEL PLAN

Building Mass:

Roof	Area	Unit Load	Mass	
High Roof:	3430	20	68600	
Tile Roof:	2810	44.8	125888	
Well Roof	6000	19	114000	
Mansard:	1450	30	43500	
Partitions	11340	5	56700	
		Total =	408688	lbs

Roof height = 18'

Floor	Area	Unit Load	Mass	
Floor	12705	100	1270500	
Ext. Walls	1140	100	114000	
Partitions	11340	10	113400	
		Total =	1497900	lbs

Floor height = 12'

Upper Level Seismic Loads:

Wood frame roof with plywood diaphragm. Concrete shear walls

Wall	Length	Rigidity	Relative R
SW1.2.1	19.5	7415	0.5
SW1.2.2	19.5	7415	0.5
		14830	
SW5.2.1	19.5	7415	0.5
SW5.2.2	19.5	7415	0.5
		14830	

Wall	Length	Rigidity	Relative R
SWA.2.1	19.5	7415	0.455
SWA.2.2	8.5	614	0.038
SWA.2.3	9.5	857	0.053
SWA.2.4	19.5	7415	0.455
		16301	
SWF.2.1	16	4096	0.562
SWF.2.2	13	2197	0.301
SWF.2.3	10	1000	0.137
		7293	

Program PL-09: Base Shear

Total Base shear = 73 kips

Load to each shear wall line = 36.5 kips

Wall	Shear	Wall	Shear
SW1.2.1	18.25	SW5.2.1	18.25
SW1.2.2	18.25	SW5.2.2	18.25
"1" Total:	36.50	"5" Total:	36.50

Wall	Shear	Wall	Shear
SWA.2.1	16.60	SWF.2.1	20.50
SWA.2.2	1.38	SWF.2.2	11.00
SWA.2.3	1.92	SWF.2.3	5.00
SWA.2.4	16.60	"F" Total:	36.50
"A" Total:	36.50		

Reliability/Redundancy factor = 1.0

Lower Level Seismic Loads:

Concrete floor slab. Concrete shear walls

Wall	Length	Rigidity	Relative R
SW1.1.1	121	1771561	1
SW5.1.1	8	512	0.271186
SW5.1.2	6	216	0.114407
SW5.1.3	6	216	0.114407
SW5.1.4	6	216	0.114407
SW5.1.5	6	216	0.114407
SW5.1.6	8	512	0.271186
		1888	

Wall	Length	Rigidity	Relative R
SWA.1.1	97.5	926859	1.000
SWF.2.1	97.5	926859	1.000

Program PL-09: Base Shear

Total Base shear = 327 kips from lower level mass only

Load to each wall line from upper level = 36.5*5.5/4.5 = 44.6 kips

Longitudinal seismic distribution, Program PL-08

Load to each shear wall line

Line	Shear	
1	1.1	kips
5	415.4	kips
A	224.7	kips
F	224.7	kips

Reliability/Redundancy factor = 1.0

Calculations: Lateral
4/5/2006 Page 2

Calculations:
4/5/2006

L4

Roof Diaphragm

Load to Line A = 36.5 kips Diaphragm length = 97 ft.
Diaphragm shear = 376 plf
Existing diaphragm is 1/2" plywood w/ 10d @ 6" o.c. all edges, blocked
Allowable shear = 325 plf
Overstress = 15.8%

Chord stress = 2*36.5*121/8/97 = 11.4 kips
Existing chord is W16x31 w/ (3) 5/8" M.B. in 1/4" splice plate.
Allowable load = 3.1*3*1.33 = 12.4 kips

Maximum collector load = 36.5/121*41 = 12.4 kips
Allowable load = 3.1*3*1.33 = 12.4 kips

Shear Walls

<u>Wall SW1.2.1</u>
Wall length = 19.5 ft. Wall weight = 12*19.5*75 = 17.6 kips
Applied Lateral load = 18.25 kips Wall height = 12 ft.
Wall seismic weight = 0.179*17.6 = 3.1 kips
Program

<u>Wall SW1.2.1</u>
Wall length = 16 ft. Wall weight = 12*16*75 = 14.4 kips
Applied Lateral load = 20.5 kips Wall height = 12 ft.
Wall seismic weight = 0.179*14.4 = 2.6 kips
Program

Calculations: Lateral
4/5/2006 Page 4

Title: Upper Level

Program: PL-9,v2 SEISMIC BASE SHEAR 2001 CBC

Structural System Types

1. Bearing Wall - Light frame w/ plywood shear walls	11. Frame System - Masonry shear walls
2. Bearing Wall - Light frame w/ light shear walls	12. Frame System - Ordinary steel braced frame
3. Bearing Wall - Concrete shear walls	13. Frame System - Special steel braced frame
4. Bearing Wall - Masonry shear walls	14. Moment Frame - Special steel frame
5. Bearing Wall - Light frame w/ tension braces	15. Moment Frame - Special concrete frame
6. Bearing Wall - Steel braced frames	16. Moment Frame - Masonry frame
7. Frame System - Steel eccentric braced frame	17. Moment Frame - Ordinary steel frame
8. Frame System - Light frame w/ plywood shear walls	18. Moment Frame - Special truss steel frame
9. Frame System - Light frame w/ light shear walls	19. Cantilevered Column
10. Frame System - Concrete shear walls	**System Type Number:** 10

Roof Diaphragm Flexible/Rigid F F/R Floor Diaphragm Flexible/Rigid R F/R

Irregularity Types (place an "X" next to all that apply)

	Soft Story, story stiffness < 70% of story above or < 80% of average of the three stories above.
	Mass, story mass > 150% of adjacent stories, except lighter roofs.
	Geometry, length of story resisting system > 130% of adjacent stories, except penthouses.
	Discontinuity, in-plane offset of system > length of system.
	Weak Story, story strength < 80% of story above.
	Torsional, end bay story drift > 1.2 of average story drift for both end bays, except flexible diaph.
	Re-entrant Corners, extension in each direction > 15% of plan dimension in respective direction.
	Diaphragm Discontinuity, openings > 50% or > 50% of stiffness of adjacent stories.
	Out-Of Plane, out-of-plane offset of vertical resisting elements.
	Nonparallel, vertical load frame not parallel to lateral resisting system.

Distance to nearest active fault:	7	km.
Fault Type	B	A, B or C
Soil type (SD if unknown):	SD	SA, SB, SC, SD or SE (UBC Table 16-J)
Occupancy category:	1	1 - 5 (UBC Tab. 16-K, Determines Importance Factor & Dynamic Req's)
Number of stories:	1	
Governing Code:	1	1 = CBC, 2 = DSA, 3 = OSHPD, 4 = BSC (State Buildings)
Limitation Notes:	**None**	

Building Mass

Level	Mass (kips)	Height (ft)
1	408.7	18
2		
3		
4		
Total	408.7	

<u>**STATIC DESIGN BASE SHEAR METHOD**</u>

Design Base Shear (UBC 30-4) =	0.932	R =	5.5
Max. Required (UBC 30-5) =	0.250	Ca =	0.440
Min. Required (UBC 30-6) =	0.061	Cv =	0.717
Min. Required (UBC 30-7) =	0.081	T =	0.175
Use: Base Shear Factor (Strength) =	**0.250**	Na =	1.000
Use: Base Shear Factor (ASD) =	**0.179**	Nv =	1.120
Base Shear = 102.18 kips, **Strength Design**		I =	1.25
Base Shear = 72.98 kips, **Allowable Stress Design**			

Dynamic Analysis Check: Dynamic Analysis Is Not Required

Total Base Shear = **102.18** kips, Strength Design
Total Base Shear = **72.98** kips, Allowable Stress Design
Base Shear Loads, See following page for design shear loads

	Final Loads - **Strength Design**			Final Loads - **Allowable Stress Design**			
Level	Load	Sum Load	Diaphragm Fpx	Load	Sum Load	Diaphragm Fpx	
1	102.18	102.18	140.49	72.98	72.98	100.35	kips
2	0.00	0.00	0.00	0.00	0.00	0.00	kips
3	0.00	0.00	0.00	0.00	0.00	0.00	kips
4	0.00	0.00	0.00	0.00	0.00	0.00	kips
FT	0.00			0.00			kips

Program PL-09: Feq Upper Level.xls
4/5/2006 Page 1

Title: Lower Level

Program: PL-9,v2 SEISMIC BASE SHEAR 2001 CBC

Structural System Types

1. Bearing Wall - Light frame w/ plywood shear walls	11. Frame System - Masonry shear walls
2. Bearing Wall - Light frame w/ light shear walls	12. Frame System - Ordinary steel braced frame
3. Bearing Wall - Concrete shear walls	13. Frame System - Special steel braced frame
4. Bearing Wall - Masonry shear walls	14. Moment Frame - Special steel frame
5. Bearing Wall - Light frame w/ tension braces	15. Moment Frame - Special concrete frame
6. Bearing Wall - Steel braced frames	16. Moment Frame - Masonry frame
7. Frame System - Steel eccentric braced frame	17. Moment Frame - Ordinary steel frame
8. Frame System - Light frame w/ plywood shear walls	18. Moment Frame - Special truss steel frame
9. Frame System - Light frame w/ light shear walls	19. Cantilevered Column
10. Frame System - Concrete shear walls	**System Type Number:** 3

Roof Diaphragm Flexible/Rigid R F/R | Floor Diaphragm Flexible/Rigid R F/R

Irregularity Types (place an "X" next to all that apply)

	Soft Story, story stiffness < 70% of story above or < 80% of average of the three stories above.
	Mass, story mass > 150% of adjacent stories, except lighter roofs.
	Geometry, length of story resisting system > 130% of adjacent stories, except penthouses.
	Discontinuity, in-plane offset of system > length of system.
	Weak Story, story strength < 80% of story above.
	Torsional, end bay story drift > 1.2 of average story drift for both end bays, except flexible diaph.
	Re-entrant Corners, extension in each direction > 15% of plan dimension in respective direction.
	Diaphragm Discontinuity, openings > 50% or > 50% of stiffness of adjacent stories.
	Out-Of Plane, out-of-plane offset of vertical resisting elements.
	Nonparallel, vertical load frame not parallel to lateral resisting system.

Distance to nearest active fault:	7	km.
Fault Type	B	A, B or C
Soil type (SD if unknown):	SD	SA, SB, SC, SD or SE (UBC Table 16-J)
Occupancy category:	1	1 - 5 (UBC Tab. 16-K, Determines Importance Factor & Dynamic Req's)
Number of stories:	1	
Governing Code:	1	1 = CBC, 2 = DSA, 3 = OSHPD, 4 = BSC (State Buildings)
Limitation Notes:	**None**	

Building Mass

Level	Mass (kips)	Height (ft)
1	1498	12
2		
3		
4		
Total	1498	

STATIC DESIGN BASE SHEAR METHOD

Design Base Shear (UBC 30-4) =	1.544	R =	4.5
Max. Required (UBC 30-5) =	0.306	Ca =	0.440
Min. Required (UBC 30-6) =	0.061	Cv =	0.717
Min. Required (UBC 30-7) =	0.100	T =	0.129
Use: Base Shear Factor (Strength) =	**0.306**	Na =	1.000
Use: Base Shear Factor (ASD) =	**0.218**	Nv =	1.120
Base Shear = 457.72 kips, **Strength Design**		I =	1.25
Base Shear = 326.94 kips, **Allowable Stress Design**			

Dynamic Analysis Check: Dynamic Analysis Is Not Required

Total Base Shear = **457.72** kips, Strength Design

Total Base Shear = **326.94** kips, Allowable Stress Design

Base Shear Loads, See following page for design shear loads

	Final Loads - **Strength Design**			Final Loads - **Allowable Stress Design**			
Level	Load	Sum Load	Diaphragm Fpx	Load	Sum Load	Diaphragm Fpx	
1	457.72	457.72	457.72	326.94	326.94	326.94	kips
2	0.00	0.00	0.00	0.00	0.00	0.00	kips
3	0.00	0.00	0.00	0.00	0.00	0.00	kips
4	0.00	0.00	0.00	0.00	0.00	0.00	kips
FT	0.00			0.00			kips

Program PL-09: Feq Lower Level.xls
4/5/2006 Page 1

Program: PC-03 CONCRETE SHEAR WALL

Designation: SW1.2.1 Existing 1998 CBC

Input Data:

Wall Length	7	ft.
Wall Thickness	6	in.
Unsupported Height	12	ft.
Horizontal Bars	4	(3-9)
Spacing	12	in.
Vertical Bars	4	(3-9)
Spacing	12	in.
Single or Double Curtain	S	S/D
Left End Bar Size	8	(3-9)
Number of Bars	2	
Right End Bar Size	8	(3-9)
Number of Bars	2	
Distance From End	4	in.
Boundary Tie Bars		(3-6) if required.
Concrete Strength, f'c	3	ksi
Reinforcing Yield, Fy	40	ksi

Vertical Loads, kips: (Special = assembly, > 100 psf or garage)
Distance measured from left end of wall, ft.

Load No.	Dead, kips	Live, kips	Distance	Special (Y/N)
1	6.3		3.5	
2				
3				
4				
5				

Lateral Loads

Load No.	Force, kips	Height, ft.
1	18.25	12
2	3.1	6
3		
4		
5		
6		

Note: Program does not calculate wall self weight!

Code Minimum Checks:

Minimum Wall Vertical Reinforcing Ratio:	0.0025	Actual:	0.0028	OK
Minimum Wall Horizontal Reinforcing Ratio:	0.0025	Actual:	0.0028	OK
Maximum Vertical Reinforcing Spacing:	18	Actual:	12	OK
Maximum Horizontal Reinforcing Spacing:	18	Actual:	12	OK
Double Curtain Reinforcing Check:	Single Reinforcing Curtain Allowed			
Hooked Shear Reinforcing Check:	Hooked Shear Reinforcing IS Required			
Maximum Axial Load Check:	OK			

Shear Check:

VU = 29.9 kips Phi*VN = 72.3 kips OK

Bending Check:

MU left = 332.6 ft-kips Phi*MN = 365.3 ft-kips OK
MU right = 332.6 ft-kips Phi*MN = 365.3 ft-kips OK

Boundary Member Check:

Boundary Member Required: YES
Minimum Boundary Member Length = 12.6 in.
Minimum Boundary Member Thickness = 9.0 in.
Minimum Boundary Member Steel = 0.6 sq.in. Minimum Number Of Bars = 4
Actual Boundary Member Steel = 1.6 sq.in. Supplied Number Of Bars = 2
Maximum Tie Spacing = 0.0 in.
Length/Width Ratio Of Hoop Ties Shall Not Exceed 3
Cross Ties Or Hoops Shall Be Spaced 12 in. o.c. Maximum
Alternate Vertical Bars Shall Be Confined By Cross Tie Or Hoop Corner
Ties At Vertical Bar Splices Shall Be Spaced At 4 in. o.c. Maximum
Horizontal Wall Reinforcing Shall Be Hooked At Boundary Edge
Lap Splices Of Horizontal Reinforcing Not Allowed In Boundary Members

Program PC-03: Shear Wall SW1-2-1 Existing.xls
4/5/2006 Page 1

Program: PC-03 CONCRETE SHEAR WALL

Designation: SWF.2.1 — 1998 CBC

Input Data:

Wall Length	16	ft.
Wall Thickness	6	in.
Unsupported Height	12	ft.
Horizontal Bars	4	(3-9)
Spacing	12	in.
Vertical Bars	4	(3-9)
Spacing	12	in.
Single or Double Curtain	S	S/D
Left End Bar Size	8	(3-9)
Number of Bars	2	
Right End Bar Size	8	(3-9)
Number of Bars	2	
Distance From End	4	in.
Boundary Tie Bars		(3-6) if required.
Concrete Strength, f'c	3	ksi
Reinforcing Yield, Fy	40	ksi

Vertical Loads, kips: (Special = assembly, > 100 psf or garage)
Distance measured from left end of wall, ft.

Load No.	Dead, kips	Live, kips	Distance	Special (Y/N)
1	14.4		8	
2				
3				
4				
5				

Lateral Loads

Load No.	Force, kips	Height, ft.
1	20.5	12
2	2.6	6
3		
4		
5		
6		

Note: Program does not calculate wall self weight!

Code Minimum Checks:

Minimum Wall Vertical Reinforcing Ratio:	0.0012	Actual:	0.0028	OK
Minimum Wall Horizontal Reinforcing Ratio:	0.0020	Actual:	0.0028	OK
Maximum Vertical Reinforing Spacing:	18	Actual:	12	OK
Maximum Horizontal Reinforing Spacing:	18	Actual:	12	OK

Double Curtain Reinforcing Check: Single Reinforcing Curtain Allowed
Hooked Shear Reinforcing Check: Hooked Shear Reinforcing Not Required
Maximum Axial Load Check: OK

Shear Check:
VU = 32.3 kips Phi*VN = 152.3 kips OK

Bending Check:
MU left = 366.2 ft-kips Phi*MN = 871.5 ft-kips OK
MU right = 366.2 ft-kips Phi*MN = 871.5 ft-kips OK

Boundary Member Check:
Boundary Member Required: NO

Program PC-03: Shear Wall SWF-2-1.xls
4/5/2006 Page 1

Program: PC-03 CONCRETE SHEAR WALL

Designation: SW1.2.1 — 1998 CBC

Input Data:

Wall Length	19.5	ft.
Wall Thickness	6	in.
Unsupported Height	12	ft.
Horizontal Bars	4	(3-9)
Spacing	12	in.
Vertical Bars	4	(3-9)
Spacing	12	in.
Single or Double Curtain	S	S/D
Left End Bar Size	8	(3-9)
Number of Bars	2	
Right End Bar Size	8	(3-9)
Number of Bars	2	
Distance From End	4	in.
Boundary Tie Bars		(3-6) if required.
Concrete Strength, f'c	3	ksi
Reinforcing Yield, Fy	40	ksi

Vertical Loads, kips: (Special = assembly, > 100 psf or garage)
Distance measured from left end of wall, ft.

Load No.	Dead, kips	Live, kips	Distance	Special (Y/N)
1	17.6		9.75	
2				
3				
4				
5				

Lateral Loads

Load No.	Force, kips	Height, ft.
1	18.25	12
2	3.1	6
3		
4		
5		
6		

Note: Program does not calculate wall self weight!

Code Minimum Checks:

Minimum Wall Vertical Reinforcing Ratio:	0.0012	Actual:	0.0028	OK
Minimum Wall Horizontal Reinforcing Ratio:	0.0020	Actual:	0.0028	OK
Maximum Vertical Reinforing Spacing:	18	Actual:	12	OK
Maximum Horizontal Reinforing Spacing:	18	Actual:	12	OK

Double Curtain Reinforcing Check: Single Reinforcing Curtain Allowed
Hooked Shear Reinforcing Check: Hooked Shear Reinforcing Not Required
Maximum Axial Load Check: OK

Shear Check:
VU = 29.9 kips Phi*VN = 185.6 kips OK

Bending Check:
MU left = 332.6 ft-kips Phi*MN = 1068.4 ft-kips OK
MU right = 332.6 ft-kips Phi*MN = 1068.4 ft-kips OK

Boundary Member Check:
Boundary Member Required: NO

Program PC-03: Shear Wall SW1-2-1.xls
4/5/2006 Page 1

The following document was provided by the City of Cupertino. The seismic report was prepared by AKH, Inc in 2005.

CITY OF CUPERTINO

City Hall
10300 Torre Avenue
Cupertino, CA 95014-3255
Telephone: (408) 777-3354
FAX: (408) 777-3333

DEPARTMENT OF PUBLIC WORKS

MEMORANDUM

TO: Ralph Qualls, Director of Public Works

FROM: Terry W. Greene, City Architect December 9, 2005

SUBJECT: City Hall: Essential Facility Classification

Issue

City Hall does not now fully meet, nor was it properly modified in 1986 to fully meet the structural requirements to enable it to be classified as an Essential Facility and thereby house an Emergency Operations Center.

Background

Cupertino City Hall was designed in 1965 by San Jose architect Wilfred Blessing and San Jose structural engineer Kirk McFarland, using the 1964 Uniform Building Code. A Building Permit was issued on December 2, 1965 and construction by Pursely Construction Company of Sunnyvale, was completed on November 19, 1966, at a cost of $433,598.49. Notice of Completion was filed with the Santa Clara County Recorder's Office on December 2, 1966.

According to documents on file, the building, in December of 1965, had 24,233 square feet, was a Type 5, B-2 (1 hour) building, located in Fire Zone No. 2, and insured for $446,260. The building had offices and a Council Chamber on the main floor and an open basement, which housed mechanical and electrical equipment.

It appears that no significant work was done to the building until 1986 when the architectural firm of Holland East and Duvivier (HED) of Redwood City, and the structural engineering firm of CYGNA of San Jose was hired to develop office space in the basement and upgrade the building to Essential Facility status in accordance with the UBC.

According to the details of the attached two letters from structural engineer, Bill Knox, of Ahearn, Knox & Hyde, and subsequent conversations I've had with him, the Uniform Building Code of 1976 prescribed the structural criteria for the design of an Essential Facility. The criteria were derived from failures in the 1971 San Fernando earthquake and significantly altered two important aspects of building design; Importance Factor and concrete shear wall ductility.

The Importance Factor was created in 1976 for the design of Essential Facilities, defined as Fire and Police stations, Hospitals, and Municipal Government Disaster Operation and Communication Centers. The application of an Importance Factor of 1.5, established in 1976, resulted in a 50% increase in earthquake design loads.

Shear wall ductility was also increased in 1976, with the application of more reinforcing steel, allowing for a more gradual failure of a shear wall rather than an abrupt failure.

In 1985, when the City of Cupertino entered into an agreement with HED to build out the City Hall basement and add on to the existing Library, the City explicitly requested that City Hall be upgraded to an Essential Facility for the purposes of creating an Emergency Operations Center. The 1985 Uniform Building Code, used for the upgrades, had reduced the Importance Factor to 1.25 but retained the shear wall ductility requirements of 1976.

HED, with structural sub consultant CYGNA, designed the structural changes to the terrace and basement offices using the more conservative, and allowable, Importance Factor of 1.5 and the appropriate shear wall ductility in accordance with the 1985 Uniform Building Code.

According to Bill Knox's review of the 1986 structural calculations, the CYGNA structural engineers did a thorough analysis of the upper level but mistakenly assumed the existing shear walls were sufficiently strong enough and contained proper reinforcing. Ironically, Bill Knox was the original structural engineer of City Hall as an employee of Kirk McFarland and is quite familiar with the original design.

Unfortunately CYGNA did not catch their mistake and as a result did not modify or upgrade any of the main floor structural walls, columns or beams to meet the 1985 UBC shear wall ductility requirements. According to Bill Knox, the existing shear walls, structural columns, beams, and roof members at the main level, are currently overloaded and do not meet the code requirements of 1976 or those of 1985.

A significant contributor to the overloading comes from the tile roof, a last minute change to the original design insisted on by the public and agreed to by the City Council on January 5, 1965. Removal of the roof tile would not, however, eliminate the need for additional ductile shear walls at each corner of the building and possible other structural modifications.

Bill Knox has expressed concern to me that in an earthquake, in which the EOC would be an important City function and through which it would be expected to be operational, the upper level might partially or completely collapse and possibly prevent access to the terrace level, even if the internal terrace level offices are undamaged.

Conclusion

City Hall does not qualify as an Essential Facility, according to the criteria established in the 1976, 1985, or 2001 Uniform Building Code or the California Building Code. Since it cannot be classified as an Essential Facility, it cannot technically house an Emergency Operations Center.

Sugimura and Associates is currently underway with the Construction Document phase for City Hall, Phase 2, Lobby remodel and EOC expansion. I have instructed them to include the necessary structural upgrades for the shear walls and other structural members without making any changes to the roof. Without roof changes, approximately 110 additional linear feet of full height shear wall will be required, applied equally at the four corners.

Gene Sugimura is also available to investigate alternatives to reduce the roof loading which would in turn reduce the number of changes that need to be made to the columns and shear walls below the roof. Bill Knox has suggested that the removal of the roof tile might reduce the length of new shear wall by 10 to 15%.

Recommendation

Determine if the EOC must remain in City Hall. Alternative locations might include the Service Yard, or the Quinlan Center, if they meet Essential Facility requirements. Another alternative might be to use the Fire Station on Stevens Creek Blvd, which is an Essential Facility. Finally, a challenging but inexpensive alternative might be to purchase and use a large tent structure.

If the EOC must remain in City Hall, it is recommended that one of the following alternatives be taken:

Alternative 1

Stop the Emergency Generator project and shift the remaining funds to design and construct the necessary shear walls.

Alternative 2

Identify an additional $200,000 and expand the scope of work for the Emergency Generator project to include new shear walls.

Alternative 3

Identify approximately $350,000 additional funds and expand the scope of work of the Emergency Generator project to include new shear walls and a new roof profile and new, lighter material.

Alternative 4

Identify approximately $350,000 of additional funds for the shear walls and new light weight roof material, and identify the additional funding for the Lobby and EOC upgrades and incorporate those funds into the Emergency Generator project for construction in April of 2006.

akh AHEARN, KNOX & HYDE, INC.
Structural Engineers

Dennis B. Ahearn, S.E.
William S. Knox, S.E.
Tim D. Hyde, S.E.

PUBLIC WORKS
DEC 0 9 2005

December 7, 2005

Sugimura & Associates Architects
2155 S. Bascom Avenue, Suite 200
Campbell, CA 95008

Att: Gene Sugimura
Ref: Cupertino City Civic Center Remodel

Dear Gene:

Terry Greene provided me with a copy of the structural calculations that CYGNA compiled for the modifications to the building in 1986. These calculations show that CYGNA did investigate the upper level of the building for seismic loading using an importance factor as required by the 1985 Uniform Building Code.

My review of CYGNA's calculations indicated that their seismic loading agrees very closely with mine. The problem appears to be with an assumption that CYGNA made, as well as a significant omission. They assumed that the walls contain shear reinforcing but the original drawings do not specify this. For the wall reinforcing to be considered as shear reinforcing a full 180-degree hook is required at each end of each reinforcing bar in the wall. This hook is not shown on the original 1965 drawings. Typically this reinforcing is not hooked unless specifically called for. By both our calculations shear reinforcing is required and the concrete shear walls are overstressed without it.

It appears that CYGNA did not check for boundary member requirements. A boundary member is in essence a column or pilaster built into the ends of highly loaded shear walls. There is a Building Code requirement for the minimum size and reinforcing of these boundary members. The existing walls do not have the required boundary members.

At the time this building was originally designed the 1964 Uniform Building Code was in effect. This Code had no requirements for hooked shear reinforcement or boundary members. Increasing the length of the upper level concrete shear walls, as previously discussed, can reduce the stresses in the walls to the extent that neither shear reinforcing nor boundary members are required.

A possible solution to this problem that has been discussed is to remove the tile roofing and replace it with a metal standing seam roof to reduce the building's seismic mass. While this would help, it would not rectify the situation, as it would reduce the seismic loads to the shear walls by only 14%, not enough to eliminate the overstress condition.

The concrete shear walls supporting the roof structure are overstressed and we recommend that the shear walls be strengthened by increasing their length as previously discussed with you..

If you have any questions please give me a call.

Sincerely,

William S. Knox
Structural Engineer

cc Terry Greene

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1505 Meridian Ave., Suite B, San Jose, CA 95125 • Phone (408) 978-1970 • Fax (408) 267-7919

AHEARN, KNOX & HYDE, Inc. **Structural Engineers**
1505 Meridian Avenue, Suite B
San Jose, California 95125
Phone: (408) 978-1970
Fax: (408) 267-7919

LETTER of TRANSMITTAL

PROJECT: Cupertino City Hall Investigation

RECIPIENTS: **AKH Job No.** ______

(1) Terry Green
Attn: ______
Fax: ______

(2) ______
Attn: ______
Fax: ______

(3) ______
Attn: ______
Fax: ______

(4) ______
Attn: ______
Fax: ______

Date	Quantity	Description
		CYGNA Structural Calculations

Comments:
Terry,
I have made a copy of the appropriate pages. My initial review indicated that CYGNA's loading agrees very closely with mine. The problem appears to be an assumption that they made as well as an omission. They assumed that the walls contain shear reinforcing but the original drawings do not specify this. For the wall reinforcing to be considered as shear reinforcing requires a full 180 degree hook at each end and this is not shown on the drawings. By both our calculations shear reinforcing is required.
It appears that CYGNA did not check for boundary member requirements. A boundary member is in essence a column built into the ends of highly loaded walls with a specified minimum size and reinforcing. The existing walls do not have the required boundary members.
I will do a more complete check and get back to you early next week. Thanks

These Items transmitted via:
____ Mail ____ Overnight X Hand Delivered ____ Messenger
____ Picked Up ____ Separate Cover ____ Fax ____ page(s), Including this page

Sent By: Bill Knox **Date:** 11/22/2005

P:\T-Greene 11-22-05.xls.xls Rev. 6/2004

akh AHEARN, KNOX & HYDE, INC.
Structural Engineers

Dennis B. Ahearn, S.E.
William S. Knox, S.E.
Tim D. Hyde, S.E.

Post-it® Fax Note 7671	Date 11/10/05 # of pages ▸ 3
To TERRY GREENE	From GENE SUGIMURA
Co./Dept.	Co.
Phone #	Phone #
Fax # 408-777-3333	Fax #

November 10, 2005

Sugimura & Associates Architects
2155 S. Bascom Avenue, Suite 200
Campbell, CA 95008

Att: Gene Sugimura
Ref: Cupertino City Civic Center Remodel

Dear Gene;

We have completed our analysis of the existing building with reference to the current code, the 2001 California Building Code. Since we were informed at our last meeting that the facility is considered to be an Essential Facility due to the Emergency Operations Center within, we have modified our analysis to include this requirement. This requirement increases the seismic forces that the structure is required to resist by 25%.

At the time this building was originally designed the 1964 Uniform Building Code was in effect. This Code had no provisions for Essential Facilities. The 1976 Uniform Building Code introduced an Importance Factor to be used in the design of Essential Facilities to resist earthquake loads. This was done due to the damage caused by the 1971 San Fernando earthquake to structures that are considered essential in the aftermath of disasters. Many of these buildings were not able to operate. An Essential Facility is defined by the Code as 1) Hospitals, 2) Fire and Police Stations and 3) Municipal Government Disaster Operation and Communication Centers. The initial Importance Factor in the 1976 Code was 1.5, resulting in a 50% increase in the earthquake loads on an Essential Facility compared to the earthquake loads on a non-essential building. The Importance Factor was reduced to 1.25 in the 1985 Uniform Building Code. This requirement has been carried on through the current Code.

Another change made in the 1976 Uniform Building Code was to increase the requirements regarding concrete shear walls. During the San Fernando earthquake non-ductile concrete construction received considerable damage. Non-ductile concrete is that which may experience compression or shear failure, which can result in a sudden and catastrophic failure. Ductile concrete is that in which the reinforcing steel yields prior to concrete failure. This results in a failure that is much slower in occurring and with less devastating results. Highly loaded shear walls are required to meet ductility requirements of the building codes since 1976.

Our analysis shows that the existing structure generally has the strength to resist the required loads. The exception to this is the second level exterior concrete shear walls. These shear walls are considerably overstressed and do not meet the ductility requirements of the current Code. These shear walls would not be allowed to be constructed today. A significant amount of new concrete walls need to be added to the existing structure to bring the building into conformance with the current Code. Enclosed is a preliminary drawing indicating recommended locations of wall additions.

The California Building Code recognizes two reasons that would require an existing building to be upgraded to the current Code, 1) Change to a more restrictive use or occupancy (CBC Section 3405) and 2) Change to the building which causes the existing building to become overloaded

1505 Meridian Ave., Suite B, San Jose, CA 95125 • Phone (408) 978-1970 • Fax (408) 267-7919

(CBC Section 3403.2). We do not know when the Emergency Operations Center was installed in this building. If it was prior to the City adopting the 1976 Building Code then there is no Code requirement for the building to be brought into conformance with the current Code. If it was installed after the 1976 Building Code then the structure should have brought into conformance with the Code in force at that time. Either way, we strongly recommend that the shear wall strengthening take place as soon as possible. The current walls are overstressed for the loads required by the current Code and, most importantly, do not meet the ductility requirements for any building code since 1976.

Our analysis also indicates that the plywood roof diaphragm is overstressed by approximately 15% due to the above 25% increase in loading. This overstress could be rectified by removing the existing roofing and re-nailing the plywood sheathing around the perimeter of the building. In our opinion, the cost-to-benefit to do this would be excessive. The City should make the decision whether to upgrade the roof diaphragm and we would be available to meet and explain the situation.

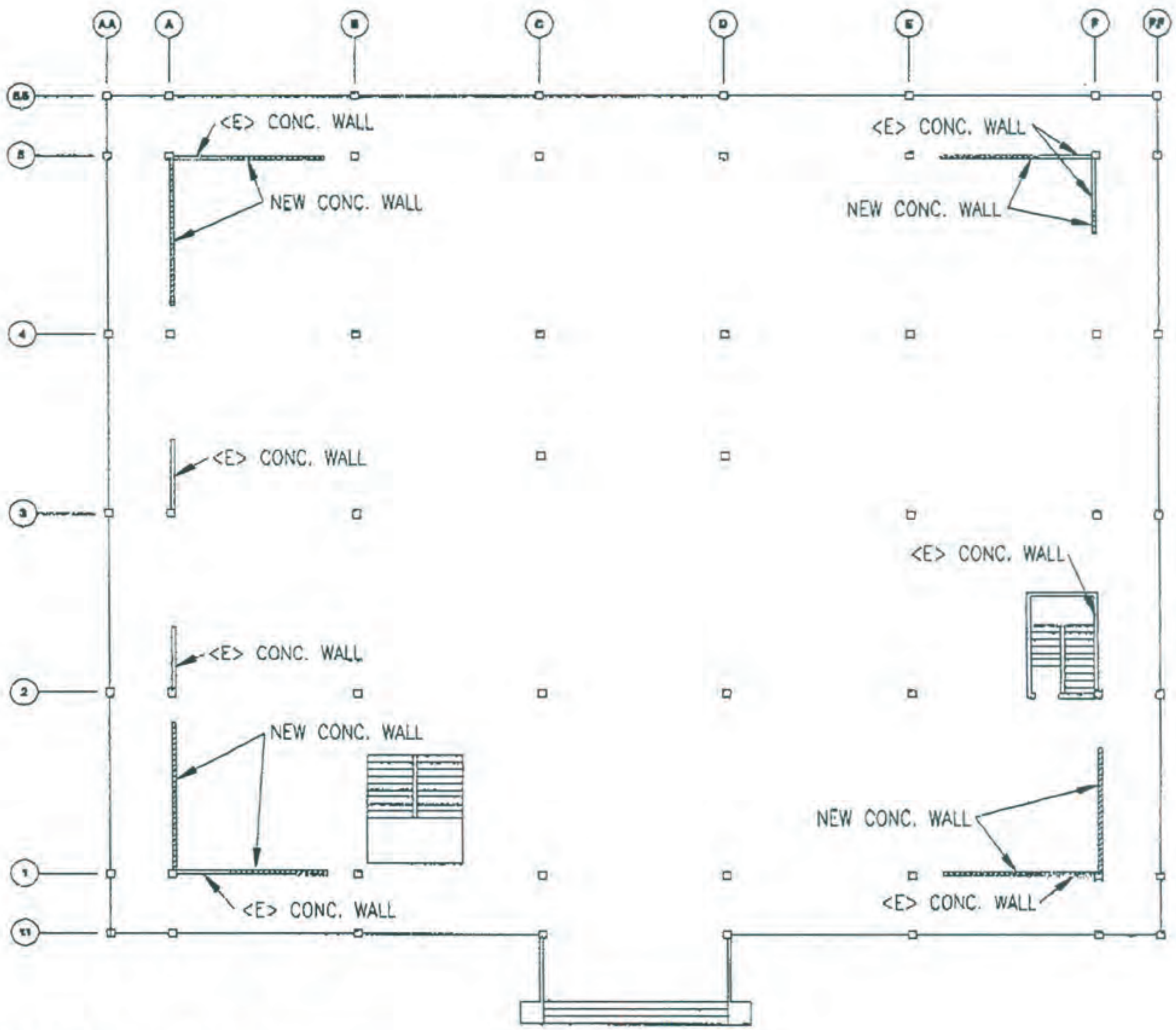
A rough cost estimate for the work of adding approximately 110 feet of new concrete shear wall, per the enclosed plan, is $130,000. This represents approximately $1,180.00 per foot of wall. This includes demolition of the existing stud walls, new concrete walls, furring the interior with gypsum board, painting, minor ceiling, floor and electrical work.

If you have any questions please give me a call.

Sincerely,

William S. Knox
Structural Engineer

NOV-10-2005 15:25 Sugimura & Associates 408 377 6066 P.03/03



FLOOR PLAN – MAIN LEVEL

The following document was provided by the City of Cupertino. The structural calculations was prepared by CYGNA in 1986.

CUPERTINO CIVIC CENTER

City Hall Remodel
Library Addition

Structural Calculations

CYGNA CONSULTING ENGINEERS
Two North Market Street, Fifth Floor
San Jose, CA 95113
408/286-6800

REGISTERED PROFESSIONAL ENGINEER
E. A. HAVERLAH
SE 2135
STRUCTURAL
STATE OF CALIFORNIA
EXP: 30 JUN 88

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCY · Date: 10/4/88
Subject: INDEX	Checked By: EAH · Date: MAY 89
System:	Job No.: 515021 · File No.:
Analysis No.: · Rev. No.:	Sheet No.:

	DESCRIPTION	PAGE NUMBER FROM	PAGE NUMBER TO
GENERAL	CODE INFO, BASE SHEAR, WIND	G1	
	PERIOD	G2	
	CS FACTOR	G3	
	KEY PLAN OF AREAS BY PARTS	G4	
	FLAT LOADS	G5	G7
LATERAL	KEY PLAN OF SHEAR WALLS	L1	
	ASSUMPTIONS, SHEAR TO EACH WALL LINE	L2	
	WALL PROPERTIES	L3	L4
	COLLECTOR FORCE AT EACH WALL LINE	L5	L8
	DIAPHRAGM SHEAR	L9	
	CHORD FORCES	L10	
	CHECK EXISTING NAILING CAPACITY	L11	
	CHECK EXISTING CHORD/COLLECTOR CAPACITY	L12	L18
	CHECK EXISTING SHEAR WALLS CAPACITY	L19	L32
	INVESTING STABILITY OF WALLS	L33	L38
	CHECK BOLTS CONNECTING NAILER TO COLLECTOR/CHORD	L39	
	CHECK ANCHORE BOLTS AT TOP OF SHEAR WALLS	L40A	L46
NEW WORK	NEW WORKS	NW-1	NW-6
VERIFICATION	VERIFICATION OF EXISTING CONDITION AGAINST AS ASSUMED & AS READ FROM EXISTING DRAWINGS	V-1	V-3
MISC	CHECK EXISTING CEILING FRAMING	M-1	M-3
	CHECK MECH. ENCLOSURE AT ROOF	M-4	M-5

1006.00

Existing City Hall Eval

GENERAL

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: [illegible]	Date
Subject: SEISMIC EVALUATION		Checked By: EAH	Date: MAY 86
System		Job No. 515021	File No.
Analysis No.	Rev. No.	Sheet No. GENERAL - G1	

CODE INFORMATION

BUILDING CODE(S): 1955 UBC

BUILDING DEPT. AND/OR REGULATORY AGENCIES

REVISION (11/3/85) [illegible]

BASE SHEAR

Z (SEISMIC ZONE 4) 1 ; I (OCCUPANCY FACTOR)= 1.5

K (HORIZONTAL FORCE FACTOR)= 1.33 1.00 ;T (FUNDAMENTAL PERIOD)=

S (SITE STRUCTURE RESONANCE) = 1.5 ; CS(USE)= 0.14

V = ZIKCSW= 0.279 W SAY 0.28 W

(.21)

SEE PG G2 & G5

WIND

C_e (COMBINED HEIGHT, EXPOSURE & GUST FACTOR)= 0.8

C_q (PRESSURE COEFFICIENT) = 1.3

qs (STAGNATION PRESSURE)= 13

BASIC WIND SPEED = 70

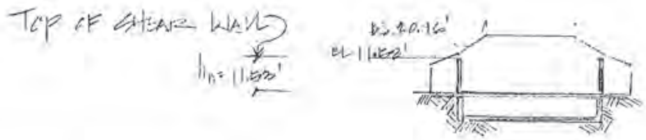
DESIGN WIND PRESSURE P = $C_e C_q q_s I$ = 15.5

WIND DOES NOT CONTROL

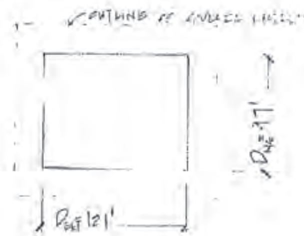
1005 00

CYGNA — Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCY	Date: 9/25/95	
Subject: GENERATION OF PERIOD	Checked By: EAH	Date: MAY/95	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: G2	



$$T = \frac{0.05\, h_n}{\sqrt{D}} = \begin{cases} \dfrac{0.05(11.83 \times 12)}{\sqrt{97}} = 0.70 \\ \dfrac{0.05(11.83 \times 12)}{\sqrt{121}} = 0.63 \end{cases}$$



1008 00

CYGNA — Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCY	Date: 11/25/95	
Subject: GENERATION OF "CS" FACTOR	Checked By: EAH	Date:	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: G3	

$$C = \frac{1}{15\sqrt{T}} = \begin{cases} 0.08 & \text{FOR } T_{NS} = 0.70 \text{ SEC} \\ 0.084 & \text{FOR } T_{EW} = 0.63 \text{ SEC} \end{cases}$$

S = 1.5 (USE – WITHOUT PROPER T_s)

$$CS = \begin{cases} 0.08 \times 1.5 = 0.12 \\ 0.084 \times 1.5 = 0.13 \end{cases} \quad \text{VS } 0.14 \text{ MAX}$$

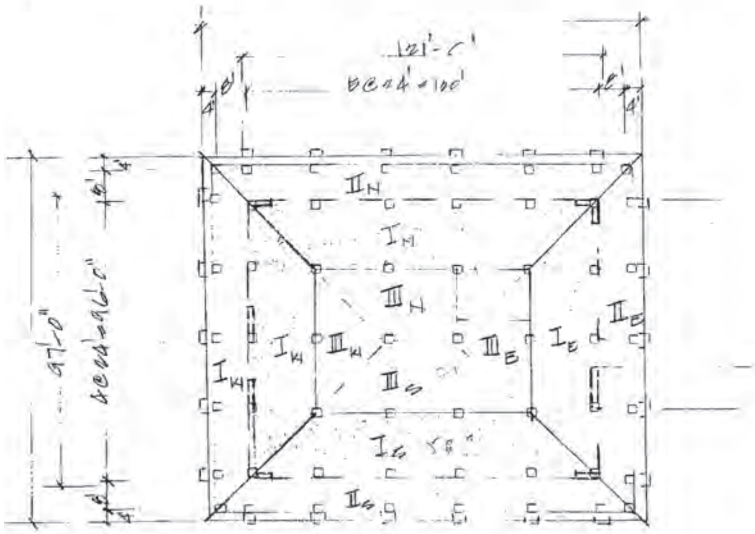
USE CS = 0.14 FOR BOTH NS & EW DIRECTION

1008 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCY	Date: 9/ /85	
Subject: KEY PLAN	Checked By: EAH	Date: MAY 85	
System:	Job No.: 5J5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: G4	



AREA MARKS	SQ. FT
$I = I_N + I_S + I_E + I_W$	= 2364 + 2364 + 1776 + 1776 = 8280
$II = II_N + II_S + II_E + II_W$	= 1596 + 1596 + 1508 + 1508 = 5608
$III = III_N + III_S + III_E + III_W$	= 1152 + 1152 + 576 + 576 = 3456
	5112 + 5112 + 3660 + 3660 = 17544 ft²

KEY PLAN

1008 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCY	Date:	
Subject: FLAT LOADS FOR SCALE ANALYSIS	Checked By: EAH	Date: MAY 85	
System:	Job No.: 5J5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: G5	

AREA III FLAT ROOF AREA

① ROOFING	7.0
② 6x14 JOISTS @ 16	4.0
③ INSULATION	0.5 ← [illegible]
④ [illegible] SUSPENSION SYSTEMS [illegible]	3.5
⑤ [illegible]	1.0
⑥ ACOUSTICAL TILE	1.0
⑦ [illegible]	2.0
⑧ METAL DECK	1.5
⑨ [illegible]	3.5
⑩ PARTITION	5.0
	29.0

SAY 29 PSF

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCM	Date: 9/[illegible]
Subject: FLAT LOADS FOR QUAKE ANALYSIS	Checked By: EAH	Date: MAY [illegible]
System:	Job No. 51502/	File No.
Analysis No.	Rev. No.	Sheet No. 96

AREA I GILTED ROOF AREA

① BARREL TILE	28
② 1/2 PLY	1.5
③ 3x T&G	7.5
④ 6x16 @ 6'-0" cc	3.7
⑤ INSULATION	0.5 ← verify
⑥ WOOD SUSPENSION SYSTEM FOR CLG	3.5
⑦ 1GB?	1.5
⑧ ACOUSTICAL TILE	1.0
⑨ 7"x19 1/2" GL	0.4
⑩ CONC COL	0.5
⑪ PARTITION	5.0
	53.1

SAY 53 PSF

1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCM	Date: [illegible]
Subject: FLAT LOADS FOR QUAKE ANALYSIS	Checked By: EAH	Date: MAY [illegible]
System:	Job No. 51502/	File No.
Analysis No.	Rev. No.	Sheet No. 97

AREA II COVERED WALKWAY AREA

① BARREL TILE	25
② 1/2 PLY	1.5
③ 2x T&G	5.5
④ 6x16 @ 6'-0" cc	[illegible]
⑤ 16 B?	5.0
⑥ 10x18 CONC BM	15.5
⑦ CONC COL.	1.7
	69.7 PSF

SAY 70 PSF

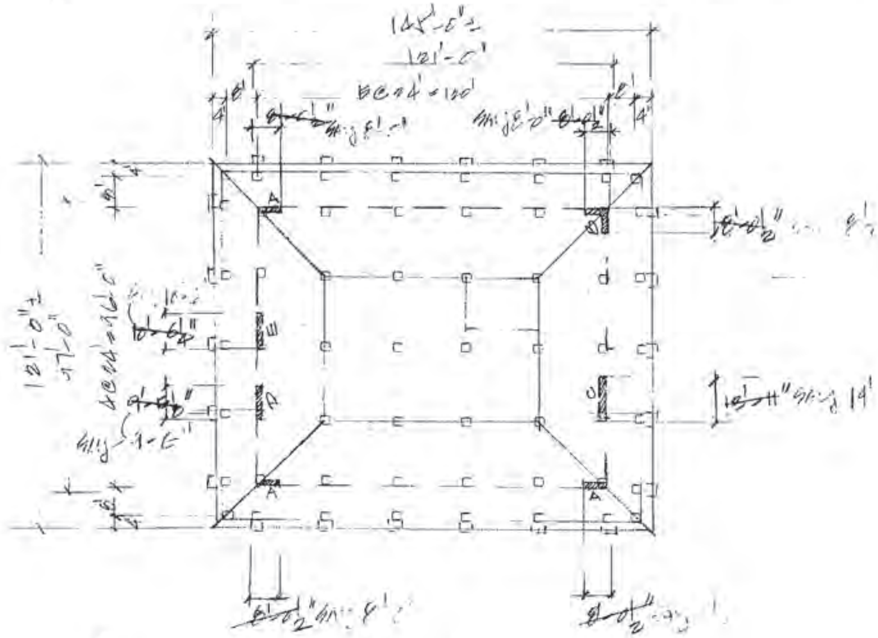
1006.00

LATERAL

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: JCY	Date: 9/26/85
Subject: LATERAL (QUAKE) ANALYSIS		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: LATERAL L1	



DENOTES EXISTING (E) 6" CONC. SHEAR WALL

KEY PLAN

N

1006 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: [illegible]	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: [illegible]	Date: [illegible]	
System	Job No. [illegible]	File No.	
Analysis No.	Rev. No.	Sheet No. L2	

ASSUMPTIONS:

1. ASSUME FLEXIBLE DIAPHRAGM (WOOD CONSTRUCTION). THEREFORE LOAD DISTRIBUTES TO CONC. [illegible] WALLS BY TRIBUTARY AREA

2. NO TORSIONAL CONSIDERATION FOR REASON OF FLEXIBLE DIAPHRAGM ASSUMPTION #1

3. CONC. [illegible] & CONC [illegible] ([illegible]) RIGIDITY BUT [illegible] OFF [illegible] RIGIDITY [illegible] IS FROM [illegible] ALONG PERIMETER OF [illegible] WALKWAY PIN CONNECTED TO EACH OTHER & AT [illegible] AREA. [illegible]

BASE SHEAR (0.28 W): 0.21

	WEIGHT (KIPS)	BASE SHEAR (KIPS)	
NORTH WALLS & SOUTH WALLS	I_N = [illegible] × 70 PSF = [illegible]	[illegible]	?
	I_N = [illegible] × [illegible] PSF = [illegible]	[illegible]	
	III_N = [illegible] × 29 PSF = [illegible]	9.4 [illegible]	57
		[illegible]	EA WALL
EAST WALLS & WEST WALLS	I_E = [illegible] × 70 PSF = 91.6	[illegible]	?
	I_E = 1776 ft² × [illegible] PSF = [illegible]	26.4	?
	II_E = 576 ft² × [illegible] PSF = 16.7	4.7	
		56.7 [illegible]	EA WALL

42.5?

1006.00

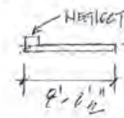
CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date	
Subject	Checked By: EAH	Date: [illegible]	
System	Job No. SJ5021	File No.	
Analysis No.	Rev. No.	Sheet No. L3	

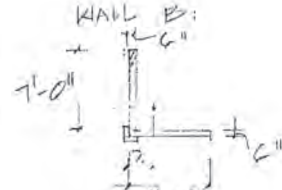
WALL TYPES (ALL WALLS OF CONSTANT HEIGHT) AND THEIR RIGIDITIES

WALL A:



$I = \frac{6(\ldots)^3}{12} = \ldots 316\ in^4$

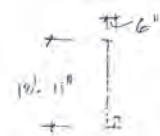
WALL B:



A	x	Ax	Ad²	I_o
540	45	[illegible]	[illegible]	[illegible]
[illegible]	3	1512	[illegible]	1512
[illegible]		[illegible]		

$\bar{x}$ = [illegible]" ΣI = [illegible] in^4

WALL C:



$I = \frac{\ldots(\ldots)^3}{12}$ = [illegible] in^4

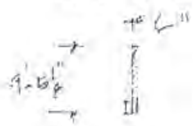
1006.00

CYGNA

Calculation Sheet

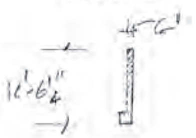
Project: CUPERTINO CITY HALL		Prepared By:	Date:
Subject:		Checked By: EAH	Date: MAY 85
System:		Job No. 5J5021	File No.
Analysis No.	Rev. No.	Sheet No. L4	

WALL D:



$$I = \frac{6(113.75)^3}{12} = 725,815\ in^4$$

WALL E:



$$I = \frac{6(146.25)^3}{12} = 1,556,155\ in^4$$

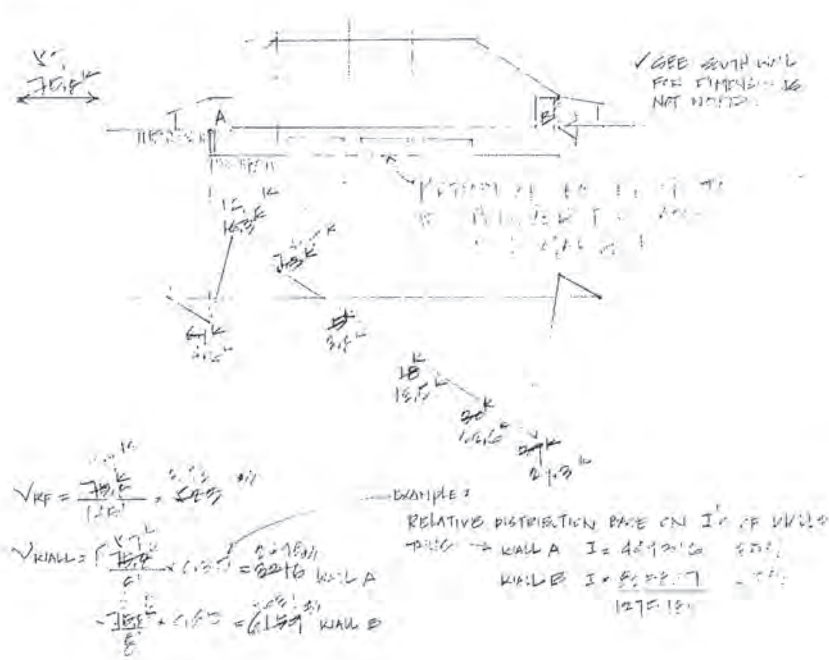
1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By:	Date: 9/26/85
Subject: LATERAL (QUAKE) ANALYSIS		Checked By: EAH	Date:
System:		Job No. 5J5021	File No.
Analysis No.	Rev. No.	Sheet No. L5	

NORTH WALL



EXAMPLE:

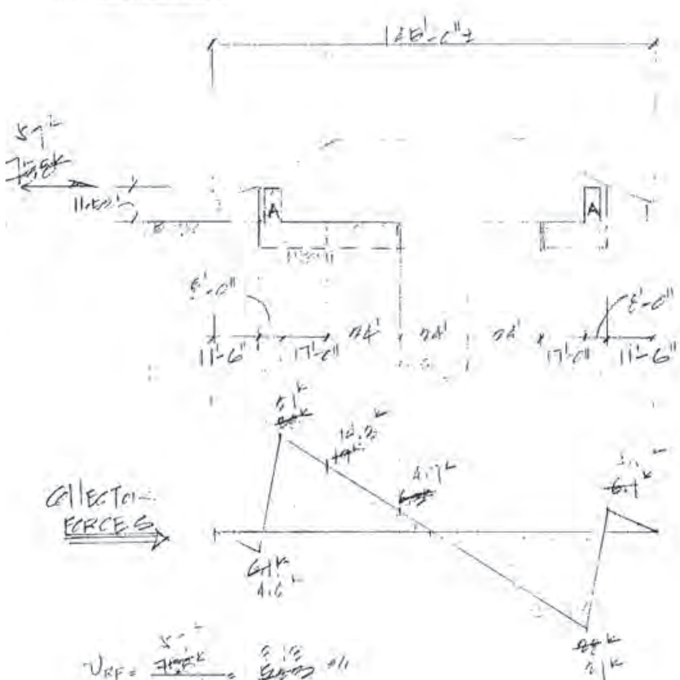
RELATIVE DISTRIBUTION BASE ON I OF WALLS

1006.00

CYGNA — Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date: 9/6/	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date: MAY 95	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L6	

SOUTH WALL



V_{RF} = 75.8k / 148' = 512 #/l

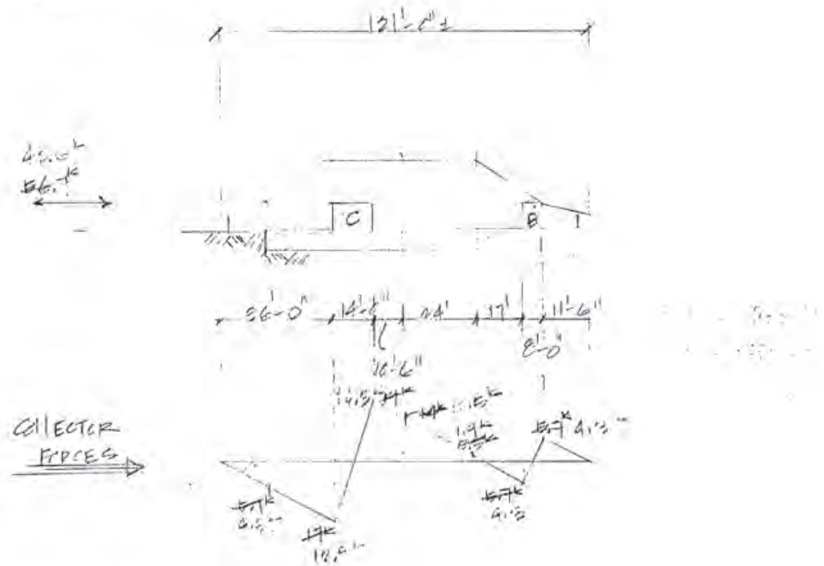
V_{WALL} = 75.8k / 16 = 4773 #/l

1006.00

CYGNA — Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date: 9/6/	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date: MAY 95	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L7	

EAST WALL



V_{RF} = 56.1k / 121' = 464 #/l

V_{WALL} = | 56.1k × 0.74 / 16' = 2497 WALL C
| 56.1k × 0.26 / 8' = 1823 #/l WALL B

DISTRIBUTION >
— RELATIVE DISTRIBUTION BASED ON I OF WALLS
THICK = 2   WALL B   I = [illegible] (26%)
WALL C   I = [illegible] (74%)

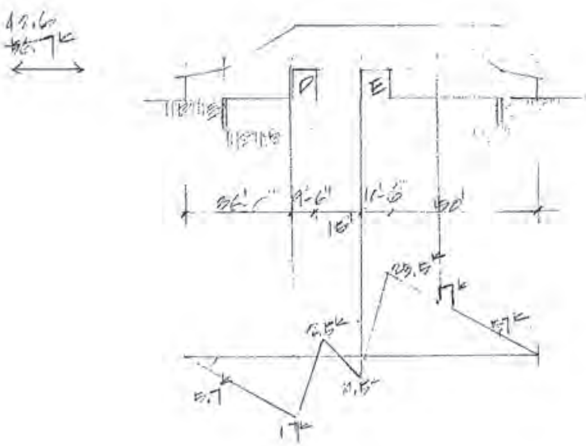
1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: Jay	Date: 9/27/85	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date:	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L8	

WEST WALL



$V_{RF} = \frac{56.7^k}{121'} = 469$ #/'

WALL P

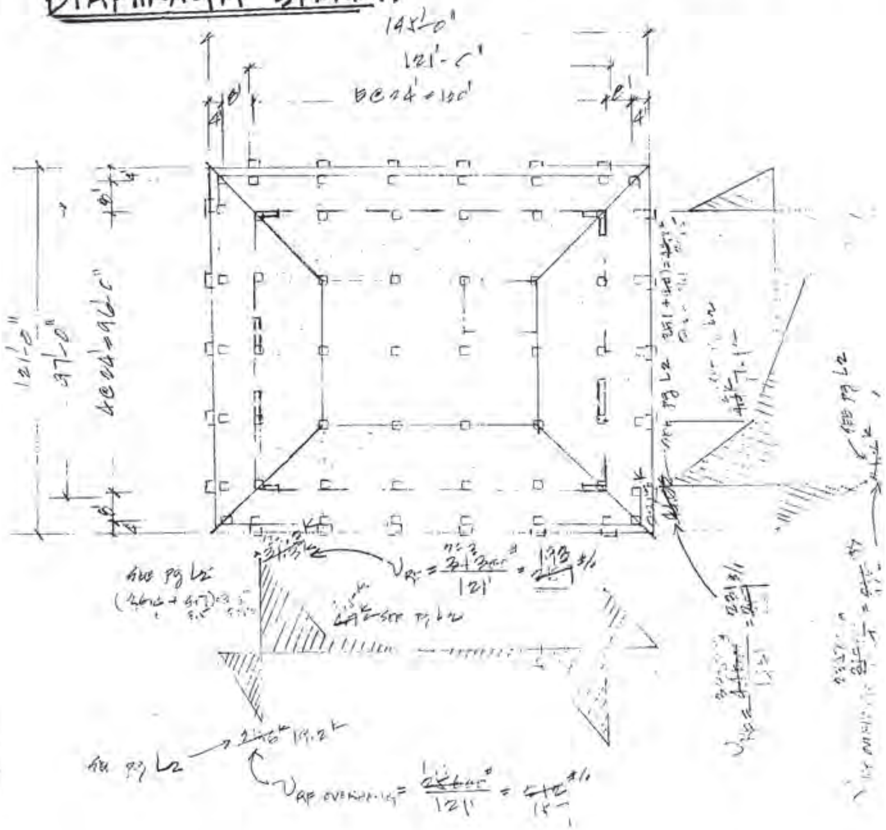
WALL E

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: Jay	Date: 9/27/85	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date: May 86	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L9	

DIAPHRAGM SHEAR:



See pg L2

See pg L2

$V_{RF} = \frac{23{,}300^{\#}}{121'}$

$V_{RF\ \text{OVERHANG}} = \frac{\ }{121'}$

1006.00

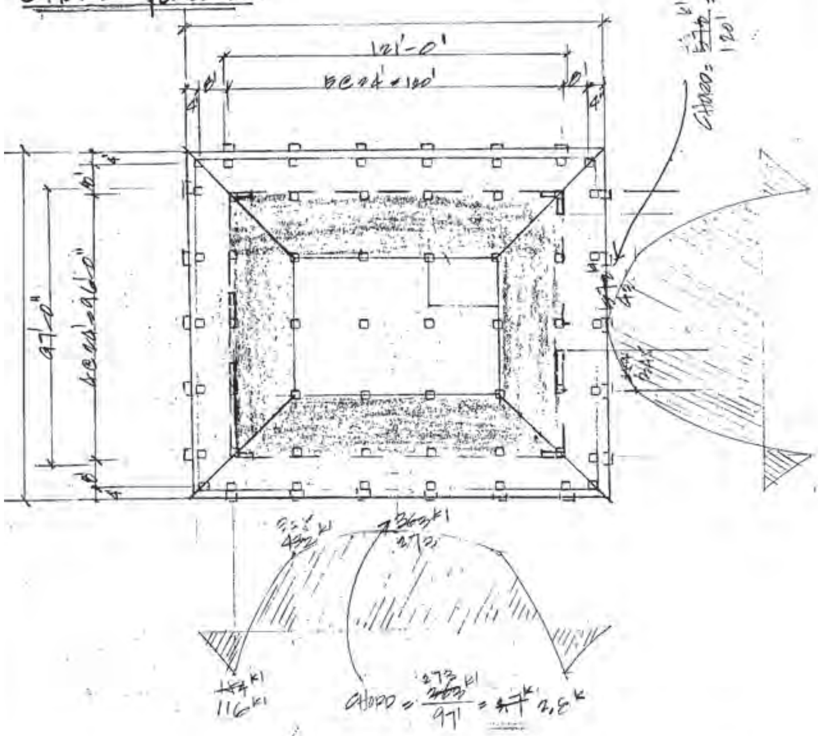
1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCY	Date: 9/2/85	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date: MAY 86	
System	Job No.: SJ 5021	File No.	
Analysis No.	Rev. No.	Sheet No.: L10	

CHORD FORCES:



1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JCY	Date	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date: MAY 86	
System	Job No.: SJ 5021	File No.	
Analysis No.	Rev. No.	Sheet No.: L11	

CHECK

EXISTING NAILING CAPACITY:

294 — 25-J-1

TABLE NO. 25-J-1—ALLOWABLE SHEAR IN POUNDS PER FOOT FOR HORIZONTAL PLYWOOD DIAPHRAGMS WITH FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE[1]

PLYWOOD GRADE	Common Nail Size	Minimum Nominal Penetration in Framing (in Inches)	Minimum Nominal Plywood Thickness (in Inches)	Minimum Nominal Width of Framing Member (in Inches)	BLOCKED DIAPHRAGMS — Nail spacing at diaphragm boundaries (all cases), at continuous panel edges parallel to load (Cases 3 and 4) and at all panel edges (Cases 5 and 6): 6 / Nail spacing at other plywood panel edges: 6	4 / 6	2½[2] / 4	2[2] / 3	UNBLOCKED DIAPHRAGM — Nails spaced 6" max. at supported end: Load perpendicular to unblocked edges and continuous panel joints (Case 1)	Other configurations (Cases 2, 3 & 4)
STRUCTURAL I	6d	1¼	5/16	2	185	250	375	420	165	125
				3	210	280	420	475	185	140
	8d	1½	3/8	2	270	360	530	600	240	180
				3	300	400	600	675	265	200
	10d	1⅝	15/32	2	320	425	640	730[2]	285	215
				3	360	480	720	820	320	240
C-D, C-C, STRUCTURAL II and other grades covered in U.B.C. Standard No. 25-9	6d	1¼	5/16	2	170	225	335	380	150	110
				3	190	250	380	430	170	125
			3/8	2	185	250	375	420	165	125
				3	210	280	420	475	185	140
	8d	1½	3/8	2	240	320	480	545	215	160
				3	270	360	540	610	240	180
			15/32	2	270	360	530	600	240	180
				3	300	400	600	675	265	200
	10d	1⅝	15/32	2	290	385	575	655[2]	255	190
				3	325	430	650	735	290	215
			19/32	2	320	425	640	730[2]	285	215
				3	360	480	720	820	320	240

UNIFORM BUILDING CODE

v 10d @ 6" cc = 360 #/' > 560 #/' AS REQUIRED.

SEE PG L9

v 8d (1/2" ...) @ 6" cc = (CTD / 1.44) × 360 #/' = 156 #/' > 185 #/' AS REQUIRED

SEE PG L9

AFTER ADJUST... R FROM ... TO 1.33 ...

1006.00

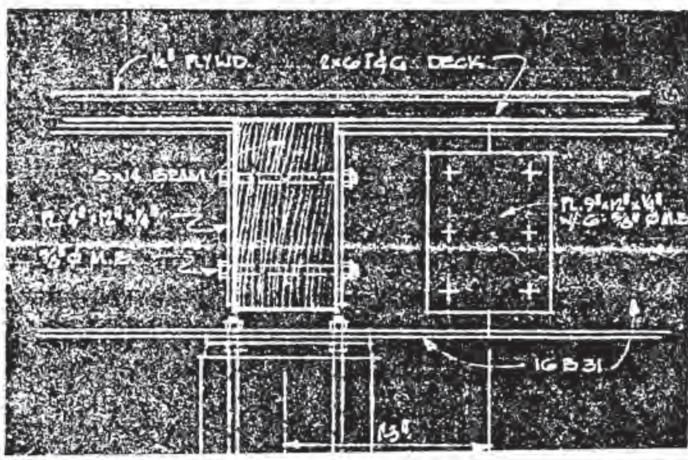
CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: 9/27/[illegible]	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date: [illegible]	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L12	

CHECK EXISTING CHORD/COLLECTOR CAPACITY:

* PROPERTIES OF 16B31 USING W16x31 OF 8TH EDITION AISC AS GUIDE LINE & ASSUME $F_y = 36$ ksi FOR SPLICE PL. & 16B31.



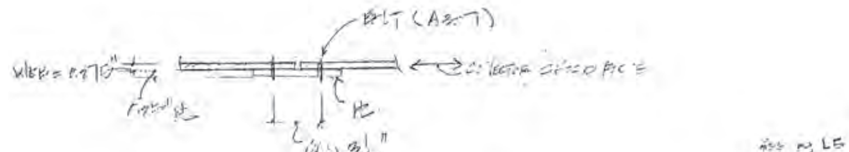
1206.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: 9/27/[illegible]	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date: [illegible]	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L13	

CHECKING SPLICE FOR COLLECTOR/CHORD FORCES



✓ BLT (NEGLECTING PRYING ACTION):

[illegible] (A307) SINGLE SHEAR = [illegible] x 3 [illegible] x 1.33 = 15.[illegible] vs [illegible]

✓ PL: $t = \frac{1}{4}$"; A = [illegible] x $\frac{1}{4}$" = [illegible] in²; r_y = 0.072 in; S_y = 0.014 in³

$F_p = 1.5 F_u$ = [illegible] ksi

[illegible] x [illegible] x 0.25" x 87 ksi = 48.9 K BEARING

$\frac{Kl}{r} = \frac{1.0(3.5)}{0.072}$ = [illegible]; F_a = 18.5 ksi

$\frac{P}{AF_a} + \frac{Pe}{S} = \frac{P}{0.25 \times 18.5} + \frac{P(0.125)}{0.014} = 1$; P = [illegible] vs [illegible]

1206.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: 4/27/85	
Subject: LATERAL (QUAKE) ANALYSIS	Checked By: EAH	Date: [illegible]	
System:	Job No.: 5J5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L 14	

NEW 1/4 PL (A36)

REPLACE EXISTING 5/8" ⌀ WITH NEW 3/4" ⌀ (A307) M.B.

NEW BOLTS:

3/4" ⌀ (A307) DOUBLE SHEAR = 11.1 k × 5 BOLTS × 1.33 = 73.3 k VS 44.6 k ECC

✓ NEW & EXISTING PL'S:

P = 18.0 ksi × 2 PL × 9" × 1/4" = 83 k VS 53.6 k ECC

OK

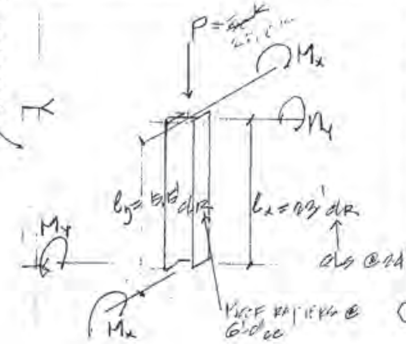
1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: 4/27/85	
Subject: ELASTIC DESIGN	Checked By: EAH	Date: [illegible]	
System:	Job No.: 5J5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L15	

COLLECTOR / CHORD MEMBER SIZE 16B31



SEE NEXT PAGE

SEE pg L16

		X-AXIS	Y-AXIS
	F_y	36	
	P	~~30~~ 53.6	
	A	9.12	
	$f_a = P/A$	~~3.29~~ 5.88	
	r	6.41	1.17
	l	276	66
	K	1.0	1.0
	Kl/r	43	56.4
	F_a	18.95	17.76
①	f_a/F_a	—	0.19 (.14)
	F_e	80.5	—
	C_m	1.0	1.0
	M	~~[illegible]~~ 73	~~0~~
	S	47.2	4.49
	$f_b = M12/S$	~~17~~ 18.7	—
	C_b	—	1.07
	r_T	—	1.39
	l/r_T	—	47.5
	F_b	22	
②	$\frac{C_m f_b}{(1-\frac{f_a}{F_e})F_b}$	~~0.83~~ 0.76	—
	$0.6F_y$	22	
③	$f_a/0.6F_y$	—	0.15 (.12)
④	f_b/F_b	~~0.77~~ 0.71	—

EQ 1.6-1a ① + ② = ~~0.19~~ 0.14 + ~~0.83~~ 0.76 + 0 = ~~0.99~~ 0.90 VS 1.33

EQ 1.6-1b ③ + ④ = 0.15 + ~~0.77~~ 0.71 + 0 = ~~0.92~~ VS 1.33

EQ 1.6-2 ① + ④ = [illegible] + [illegible] + = [illegible] VS 1.0

1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: 9/25/85	
Subject: COLLECTOR / CHORD	Checked By: EAH	Date: MAY 85	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L16	

VERTICAL LOADINGS TO COLLECTOR/CHORD:

AREA I SLOPED ROOF AREA

(1) + (2) + (3) + (4) + (5) + (6) + (8) = 45.7 PSF × 12' = 551.4 #/'
(SEE FLAT LOADS PG G6)

16B31 (MEMB. WT) = 31.0

AREA II COVERED WALKWAY AREA

(1) + (2) + (3) + (4) = 37 PSF × 4' = 148.0
(SEE FLAT LOADS PG G7) = 728.4 #/'

$M_x = \left[728 \frac{\#}{'} \times 16^2 / 8\right]\left(\frac{12}{1000}\right) = 558.1^{K''}$

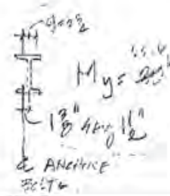
SEE PG L15: ~~24~~ 22.6 K × 16"/2 = ~~240~~ 181.9

~~798~~ 781 K''

$M_y = 29^K \times 1.5'' = 43^{K''}$

CAN NOT TRANSMIT THRU HINGE ∴ $M_y = 0^{K''}$

ECCENTRICITY @ TOP OF STEM WALL



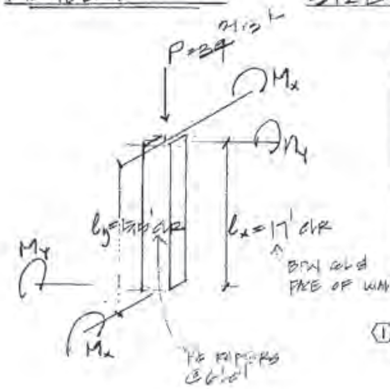
1006 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: 9/30/85	
Subject: ELASTIC DESIGN	Checked By: EAH	Date: MAY 85	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L17	

COLLECTOR/CHORD
MEMBER SIZE 16B31



		X-AXIS	Y-AXIS
	F_y	36	
	P	~~39~~ [illegible]	
	A	9.12	
	$f_a = P/A$	~~4.3~~ [illegible]	
	r	6.41	1.17
	l	204	66
	K	1.0	1.0
	Kl/r	31.8	56.4
	F_a	19.8	17.8
(1)	f_a/F_a	—	~~.24~~
	F_e'	145.8	46.8
	C_m	1.0	1.0
	M K''	~~665~~	~~58.5~~ 44
	S	47.2	4.49
	$f_b = M/S$	~~15~~	~~15~~
	C_b	—	1.0
	r_T	—	1.39
	l/r_T	—	17.5
	F_b	22	
(2)	$\frac{C_m f_b}{(1 - \frac{f_a}{F_e'}) F_b}$	.66	.65
	$0.6F_y$	22	22
(3)	$f_a/0.6F_y$	—	~~.19~~
(4)	f_b/F_b	~~.59~~	.66

SEE PG L18

EQ. 1.6-1a (1) + (2) = ~~.24~~ + .66 + ~~.65~~ = ~~1.49~~ 1.17 VS 1.33

EQ. 1.6-1b (3) + (4) = .19 + ~~.59~~ + .66 = ~~1.35~~ VS 1.33

1006 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: [illegible]	
Subject: COLLECTOR / CHORD	Checked By: EAH	Date: MAY 3[illegible]	
System:	Job No.: 515821	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L18	

VERTICAL LOADINGS TO COLLECTOR / CHORD

AREA I SLOPED ROOF AREA

SEE PAGE L16 → 45.7 PSF × 12' = 524.4 … 174.8

AREA II COVERED WALKWAY AREA

SEE PAGE L16 → 27 PSF × 6 = 162 … 67.5 … 115.0 … 546

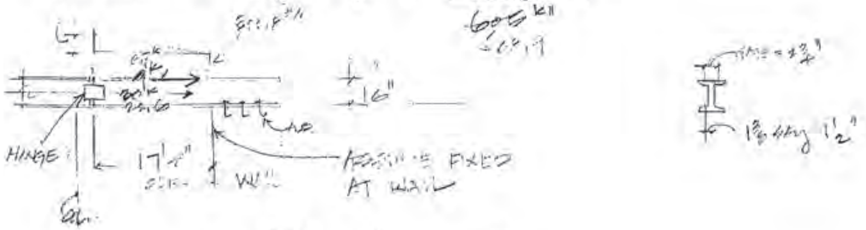
$$\frac{346.5 \times 17^2}{8} = 140$$

$$\frac{304.6 \times 17^2}{15} = 81$$

$$67^k \times 16'' = 144 \;\; 107$$

$$30^k \times 8'' = 240 \;\; 187.9$$

605 k' … 265.9



$$M_y = 39^k \times 1\tfrac{1}{2}'' = 58.5^{k'}$$

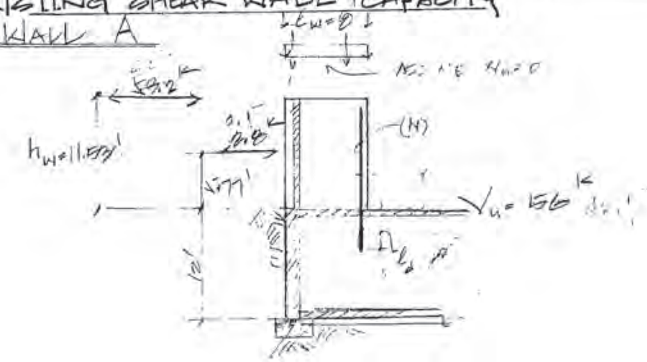
CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: [illegible]	Date: 10/1/85	
Subject:	Checked By: EAH	Date: MAY 3[illegible]	
System:	Job No.: 515821	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L19	

EXISTING SHEAR WALL CAPACITY

WALL A



$\phi 10\sqrt{f'_c}\, t\, 0.8 l_w = 214.5^k$ vs $V_u = 56$

$V_c = 2\sqrt{f'_c}\, t\, 0.8 l_w = 56.5^k$ vs $V_u = 56$ REQ

$A_v = \left(\frac{V_u/\phi - V_c}{f_y d}\right) S_2$ = [illegible] vs #4 @ 12" cc

$\frac{l_w}{5} = 19.2$, $3t = 18$, $18''$ } 18 vs $S_2 = \#4 @ 12''$cc

$\rho_h = \frac{0.2}{t S_2} = 0.00278$ vs 0.0025

$\rho_n = [0.0025;\; 0.0025 + 0.5(2.5 - \frac{h_w}{l_w})(\rho_h - 0.0025) = 0.0027]$ 0.0025

$\rho_h = 0.00278$

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: JY	Date: 12/1/85	
Subject:	Checked By: EAH	Date: MAY 86	
System:	Job No. 515021	File No.	
Analysis No.	Rev. No.	Sheet No. L20	

ρ_n (ACTUAL) = $\frac{0.2}{t\, s_1}$ = 0.0028

$\frac{l_w}{3}$ = 32
3t = 18
18"

18 vs s_1 = #4 @ 12" cc

EXISTING #4 @ 12" cc fy = 40 ksi

$M_u = V_u h_w$ = 629.5 (47 k) see pg L21

$F_u = \frac{t\, l_w^2}{12000} = \frac{6 \times 96^2}{12000}$ = 4.05

$K_u = \frac{M_u}{F_u}$ = 155.4 ; ρ_{REQ} = 0.0045

$A_{s\,(REQ)}$ = 2.4 in²

$\rho = \frac{1.58}{t \cdot l_w}$ = 0.0028

1.58 − 1.58 = 0.92 in²

fc = 3
fy = 40

SEE pg L23A FOR ALTERNATE

CYGNA

Calculation Sheet

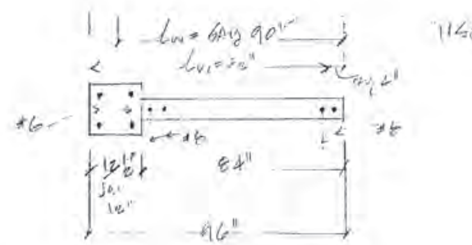
Project: CUPERTINO CITY HALL	Prepared By: JY	Date: 12/1/85	
Subject:	Checked By: EAH	Date: MAY 86	
System:	Job No. 515021	File No.	
Analysis No.	Rev. No.	Sheet No. L21	

WALL A

V_u = 0.15 ksf × 8' × 0.5' × 11.833' + ... = ... × 1.6 = ...

M_u = ... × 3.77 = 16.2

H_u = INSIGNIFICANT



CYGNA — Calculation Sheet

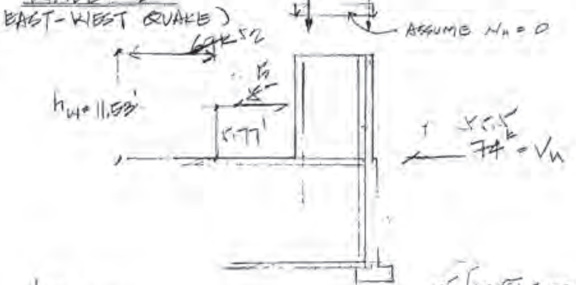
Project: CUPERTINO CITY HALL		Prepared By: [illegible]	Date: 9/30/85
Subject:		Checked By: EAH	Date: May 86
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: L22	

CHECK EXISTING SHEAR WALL CAPACITY.

WALL B

(EAST-WEST QUAKE)

ASSUME $N_u = 0$



$\frac{h_w}{l_w} = 1.44$

$10\sqrt{f'_c}\ t\ 0.8\ l_w = 214.5^k$ MAX

$V_c = 3.3\sqrt{f'_c}\ t\ 0.8\ l_w + \frac{N_u d}{4 l_w}$ ... ; $V_c \ V_u = 74$ REQ.

$V_c = 2\sqrt{f'_c}\ t\ 0.8\ l_w = 50.5^k <$ UBC 85 REQUIRED TWO CURTAINS WHEN $V_c < V_u$ OK

$A_v = \left(\frac{V_u - \phi V_c}{\phi f_y d}\right) S_2 = .14$ ... vs #4 @ 12" cc OK

$\frac{l_w}{5} = 19.2"$
$3t = 18$
$18"$
} 18 vs S_2 = #4 @ 12" cc OK

$\rho_h = \frac{.12}{t \cdot S_2} = 0.0028$ vs ... OK

$\rho_n = [0.0025;\ 0.0025 + 0.5(2.5 - \frac{h_w}{l_w})(\rho_h - 0.0025) = 0.0025]$ 0.0025

$\rho_n = 0.0025$

CYGNA — Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: [illegible]	Date:
Subject:		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: L23	

$\rho_n (\text{ACTUAL}) = \frac{0.12}{t\ S_1} = 0.0028$ OK

$\frac{l_w}{3} = 32$
$3t = 18$
$18"$
} 18 vs S_1 = #4 @ 12" cc

EXISTING #4 @ 12" cc $f_y = 40$ ksi

$M_u = V_u h_w = 824^{k'}$ SEE pg L24

$F_n = \frac{t\, l_w^2}{12000} = \frac{6 \times 96^2}{12000} = 4.05$

$K_n = \frac{M_u}{F_n} = 203.5$; $\rho_{REQ} = 0.0026$

$A_s (REQ) = 0.0026 \times 6 \times 90 = 1.39$ in vs [... #9 ...] OK

$\rho = \frac{1.58}{t \cdot l_w} = 0.0028$

$\ldots 1.58 = 0.82$ ...

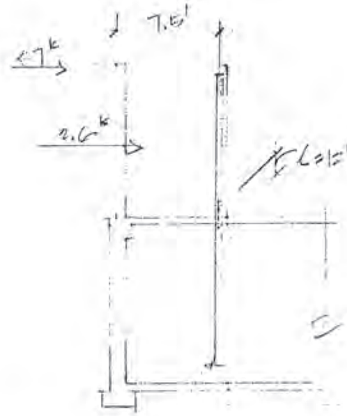
[illegible] #9 $f'_c = 3$, $f_y = 40$

SEE pg L23A FOR ALTERNATIVE APPROACH.

CYGNA Calculation Sheet

Project	CUPERTINO CITY HALL	Prepared By:	[illegible]	Date	
Subject		Checked By:	EAH	Date	MAY [illegible]
System		Job No.	SJ5021	File No.	
Analysis No.	Rev. No.	Sheet No.	L23A		

ALTERNATE APPROACH TO REINFORCE EXISTING [illegible] SAME FOR WALL B (WALL A SIMILAR)



M_f (SERVICE) = 422 k'

$T = \frac{422^{k'}}{7.5'} = 56^k$

$\frac{KL}{r_y} = \frac{1.0 \times 12}{0.144}$

$F_y = 15$ ksi

$f_a = \frac{T}{A} = 13.75$ ksi

$\frac{f_a}{F_a} = 0.98 < 1.33$

TRY A PL 8" x 1/2

A = 4 in²

r_y = 0.144

N (f'_c = 5 ksi) = 59k / [illegible] = 13 [illegible]

[illegible]

| PL 8 x 1/2 [illegible] WITH [illegible] (AS [illegible]) [illegible] |

CYGNA Calculation Sheet

Project	CUPERTINO CITY HALL	Prepared By:	[illegible]	Date	[illegible]
Subject		Checked By:	EAH	Date	MAY [illegible]
System		Job No.	SJ5021	File No.	
Analysis No.	Rev. No.	Sheet No.	L24		

WALL B (EAST-WEST QUAKE) SEE pg 61

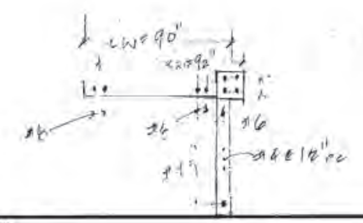
V = [0.15 ksf × 1229 in² / 144 × 11.53 × 0.95 = 31.4 × 1.4 = 44k
  158k × 0.615 = 49.3 × 1.4 = 69k
  (SEE pg 65) — 80.8

V_u = 80.8 × 1.4 = 74k

M_u = [49.3 × 11.53' = 568.4
  31.4 × 8.77' = 275.2
  — 843.6 k' × 1.4 = 1184 k'

H_u = 1.4 × 32.7k (SEE pg L33) ASSUME INSIGNIFICANT FOR VERTICAL CHORD CONSIDERATION

(SEE pg L41)



CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By:	Date:
Subject:		Checked By: EAH	Date: MAY 85
System:		Job No. SJ5021	File No.
Analysis No.	Rev. No.	Sheet No. L25	

CHECK EXISTING SHEAR WALL CAPACITY.

WALL C

ASSUME $N_u = 0$

$\frac{h_w}{l_w} = 1.82$

$\phi 10\sqrt{f'_c}\, t\, 0.8 l_w = 375.4^k$ MAX

$V_c = 2\sqrt{f'_c}\, t\, 0.8 l_w = 88.3^k$ $\quad \frac{\phi V_c}{2} = 37.5$

$A_v = \left(\frac{V_u - \phi V_c}{\phi f_y d}\right) S_2 = \sim$

VS $V_u = 63.5^k$ REQ

VS V_u REQ

VS #4 @ 12" cc (OK)

$\frac{l_w}{5} = 33.6$, $3t = 18$, $18"$ → 18 VS $S_2 = $ #4 @ 12" cc (OK)

$\rho_h = \frac{0.12}{t S_2} = 0.0028$ VS 0.0025

$\rho_n = \left[0.0025 + 0.5\left(2.5 - \frac{h_w}{l_w}\right)(\rho_h - 0.0025) = 0.0028 \right]$ 0.0025 ✓

$\rho_n = 0.0028$

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By:	Date:
Subject:		Checked By: EAH	Date: MAY 85
System:		Job No. SJ5021	File No.
Analysis No.	Rev. No.	Sheet No. L26	

$\rho_n (\text{ACTUAL}) = \frac{0.12}{t S_1} = 0.0028$

$\frac{l_w}{3} = 56$, $3t = 18$, $18"$ → 18 VS $S_1 = $ #4 @ 12" cc (OK)

EXISTING # 4 @ 12" cc $f_y = 40$ ksi

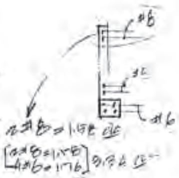
$M_u = V_u h_w = 704.5$

$F_u = \frac{t l_w^2}{12000} = \frac{6 \times 161^2}{12000} = 12.96$

$K_u = \frac{M_u}{F_u}$ → $\rho_{REQ} = 0.0015$

$A_s (\text{REQ}) = 1.48\ in^2$ VS {2 #8 = 1.58 ... ; 3.34 ...}

$\rho = \frac{1.58}{t \cdot l_w} = 0.0028$



EXISTING # $f'_c =$ $f_y =$

CYGNA

Calculation Sheet

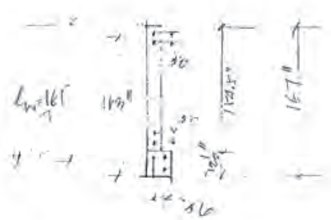
Project: CUPERTINO CITY HALL	Prepared By:	Date:	
Subject:	Checked By: EAH	Date:	
System:	Job No: 515021	File No:	
Analysis No:	Rev. No:	Sheet No: L2??	

WALL C

$N_u = \begin{cases} 0.15 kcf \times 13.92' \times 0.5' \times 11.53' \times \ldots = 3.6 \times 1.4 = \ldots \\ 56.7^k \times 0.74 = 42 \times 1.4 = 58.7 \end{cases}$

$M_u = \begin{cases} 4.8^k \times 5.77' = 27.7 \\ 58.7 \times 11.53 = 676.8 \\ 704.5^{k'} \end{cases}$

H_u = INSIGNIFICANT



1008 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date:	
Subject:	Checked By: EAH	Date:	
System:	Job No: 515021	File No:	
Analysis No:	Rev. No:	Sheet No: L2??	

CHECK EXISTING SHEAR WALL CAPACITY.

WALL D

$h_w / l_w = 1.2$

$10\sqrt{f'_c}\, t\, 0.8\, l_w = 254.8^k_{max}$

$V_c = 2\sqrt{f'_c}\, t\, 0.8\, l_w = 6?^k$ $\quad \phi V_c / 2 = 25.5$ $\quad$ vs V_u = ... REQ

vs V_u = 36.6 REQ

$A_v = \left(\frac{V_u - \phi V_c}{\phi f_y d}\right) S_2 = \sim$ $\quad$ use #4 @ 12" oc

$\left.\begin{array}{l} l_w/5 = 22.8 \\ 3t = 18 \\ 18" \end{array}\right\}$ 18 vs S_2 = #4 @ 12" oc

$\rho_h = \frac{A_v}{t S_2} = 0.0028$ vs 0.0025

$\rho_n = \begin{cases} 0.0025 \\ 0.0025 + 0.5(2.5 - \frac{h_w}{l_w})(\rho_h - 0.0025) = 0.0027 \\ \rho_h = 0.0028 \end{cases}$ 0.0025

1008 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date:	
Subject:	Checked By: EAH	Date: MAY/85	
System:	Job No. 5J5021	File No.	
Analysis No.	Rev. No.	Sheet No. L45	

$\rho_n (\text{ACTUAL}) = \frac{0.2}{t\, s_1} = 0.0028$

$\frac{l_w}{3} = 38$
$3t = 18$
$18''$
] 18 in $s_1 = \#4 @ 12'' cc$

EXISTING # 4 @ 12" cc fy = 40 ksi

SEE pg L46

$M_u = V_u h_w = 403.1$ k'

$F_n = \frac{t\, l_w^2}{12000} = \frac{6 \times 107^2}{12000} = 5.7$

$K_n = \frac{M_u}{F_n} = 70.4$; $\rho_{reqd} = 0.0012$

$A_s (\text{REQD}) = 1.27$ in² vs $\left\{ \begin{array}{l} 1\#9 = 1.0 \\ \left[\begin{array}{l} 1\#9 = 1.0 \\ 3\#6 = 1.76 \end{array}\right] 2.76 \end{array} \right.$

$\rho = \frac{1}{t \cdot l_w} = 0.0015$

EXISTING # fc = 3 fy = 40

1008 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date:	
Subject:	Checked By: EAH	Date: MAY 85	
System:	Job No. 5J5021	File No.	
Analysis No.	Rev. No.	Sheet No. L46	

WALL D

$V_u = [0.15 \text{ ksf} \times 11.6' \times 5.5' \times 11.53' \times 0.28 \ldots$

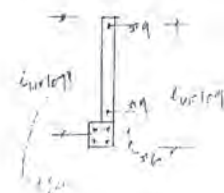
$5.7' \times 0.12$

$1.4 M_u = [\ldots \times 5.77 = 19.2 \ldots$

$33.3 \times 11.53 = 383.9$

403.1

$N_u = \text{INSIGNIFICANT}$



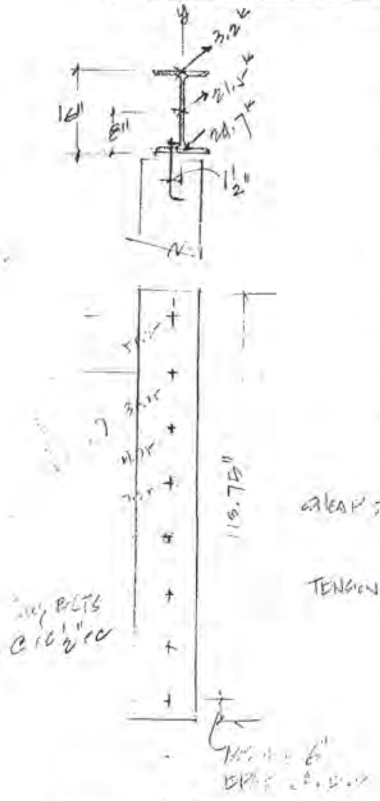
1008 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: JCY	Date:
Subject:		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: L46	

ANCHORE BOLTS OVER WALL E



$M_y = 24.7 \times 1.5'' = 37 \text{ k}''$

$M_x = \begin{cases} 3.2 \times 16'' = 51.2 \\ 21.5 \times 8'' = 172 \end{cases} = 223.2 \text{ k}''$

$\Sigma d^2 = \Sigma h^2 + \Sigma v^2 = 883.1$

$H = \dfrac{37 \, (M_y) \times 50.75}{883.1 \, (\Sigma d^2)} = 0.21$

$V = \dfrac{24.7}{8 \text{ BOLTS}} = 3.1$

SHEAR → $R = (H^2 + V^2)^{\frac{1}{2}} = 3.1$ OK Vs 5.5 (UBC)

TENSION → $T = \dfrac{223.2 \, (M_x) \times 50.75}{883.1 \, (\Sigma d^2)} = 1.3$ Vs 4.3

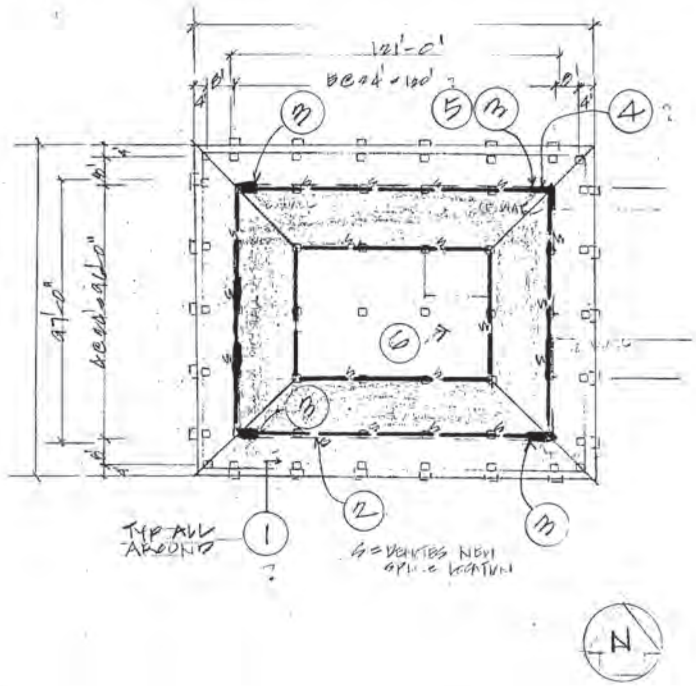
1008.00

Hekl Works

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date: 9/ /85	
Subject: KEY PLAN FOR NEW WORK	Checked By: EAH	Date:	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.:	



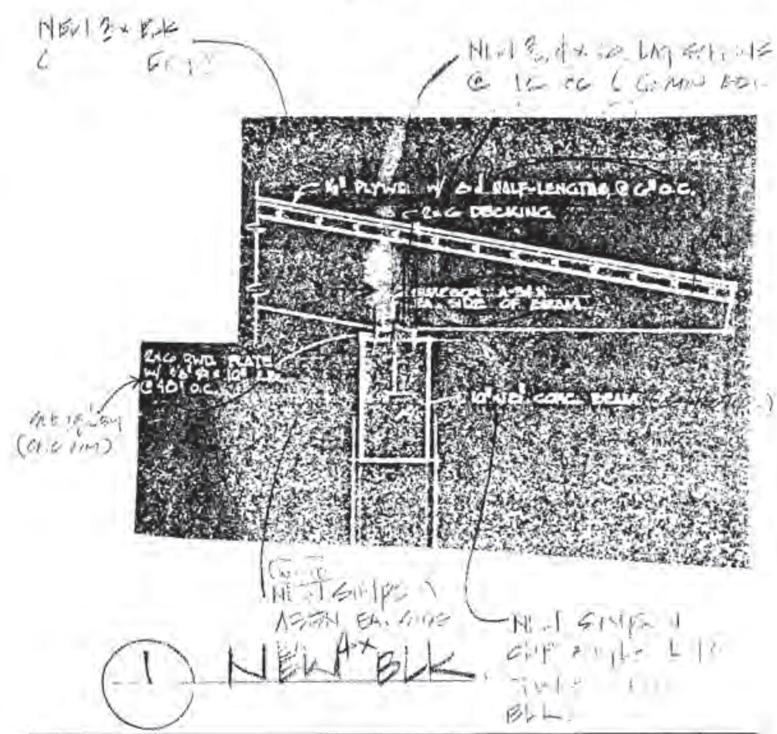
1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date:	
Subject:	Checked By: EAH	Date:	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: NW-1	

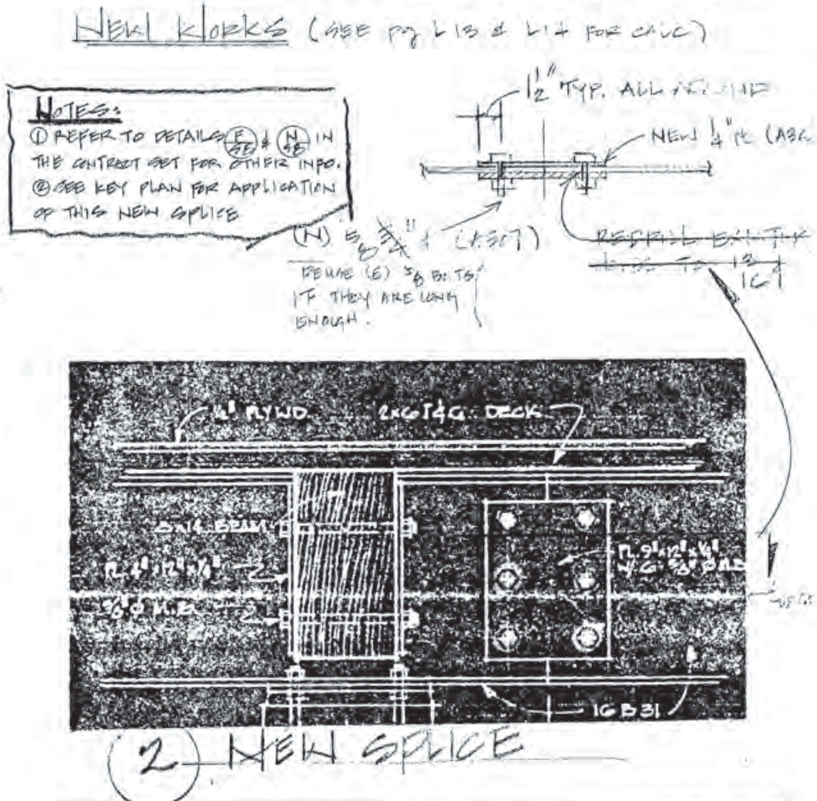
NEW WORKS (JUST JUST A SUGGESTION – NO CALC)



CYGNA

Calculation Sheet

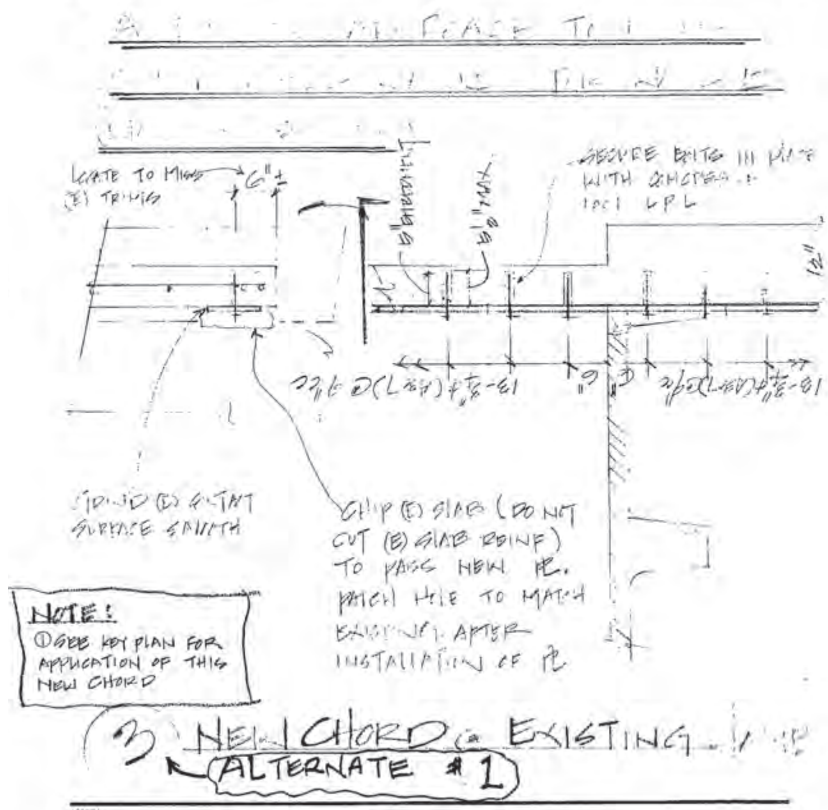
Project: CUPERTINO CITY HALL	Prepared By:	Date:	
Subject:	Checked By: EAH	Date:	
System:	Job No. 5J5021	File No.	
Analysis No.	Rev. No.	Sheet No. NW-2	

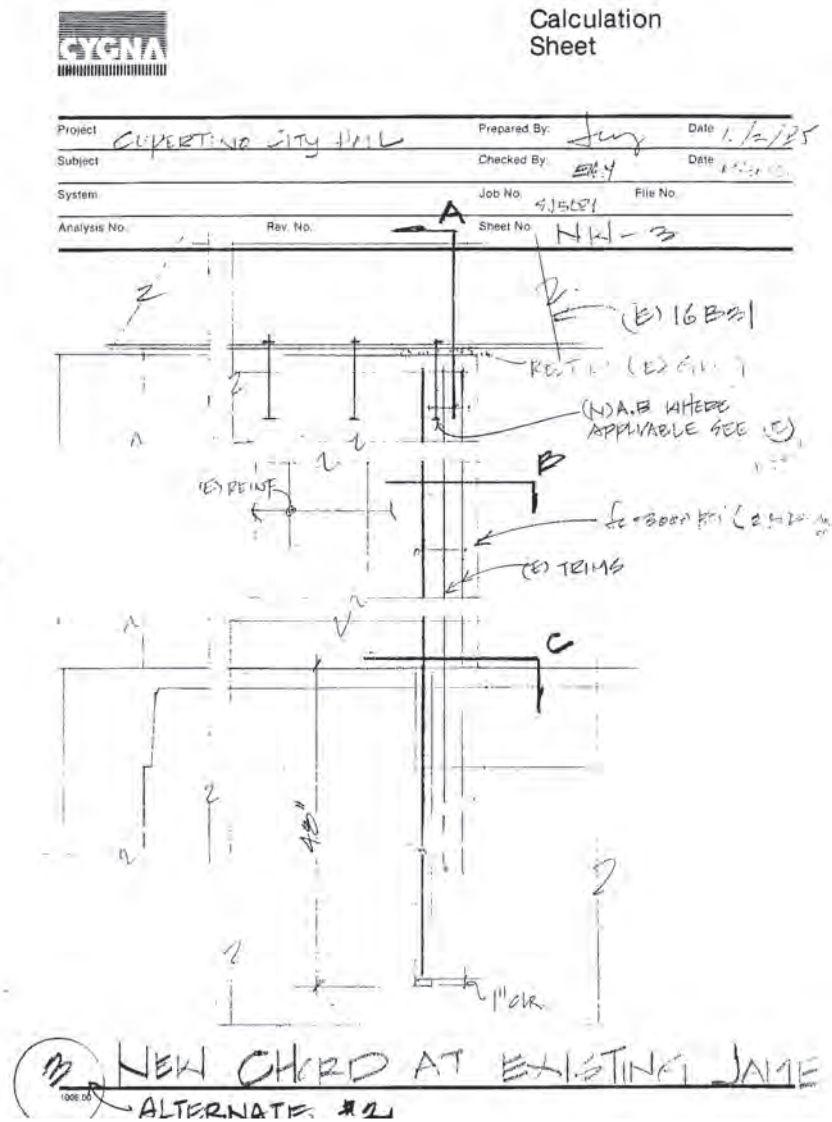


CYGNA

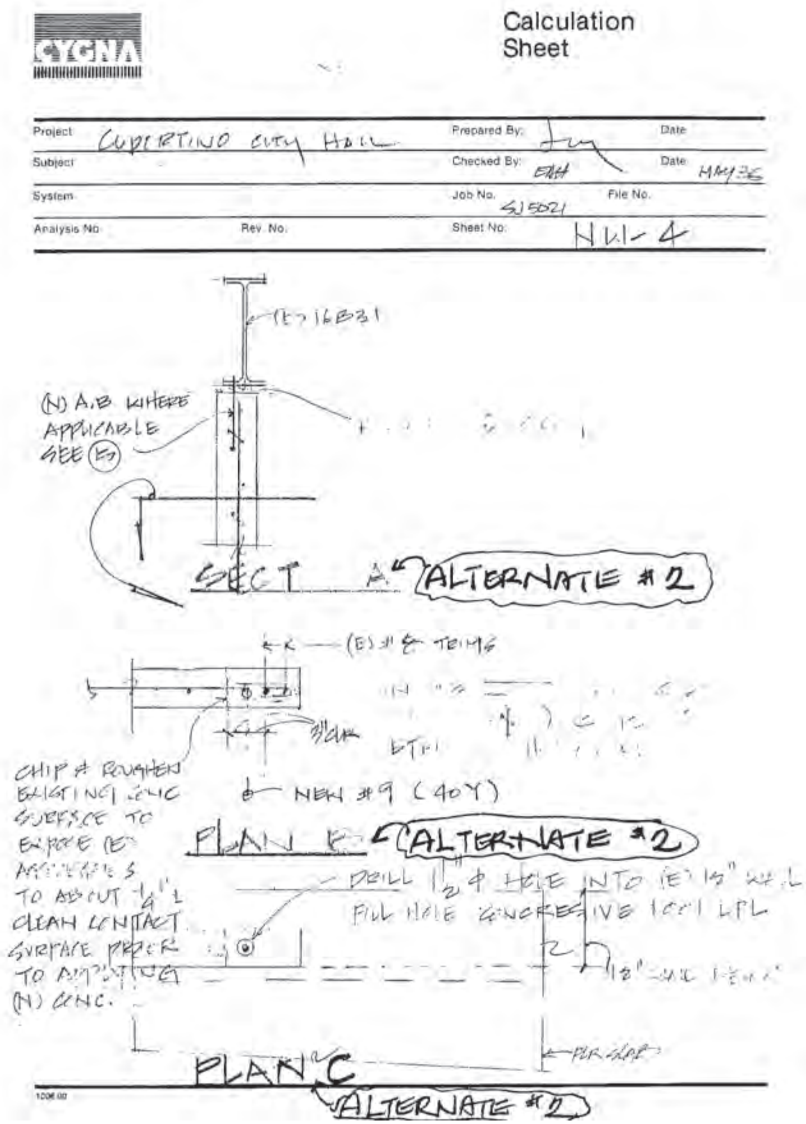
Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date:	
Subject:	Checked By: EAH	Date:	
System:	Job No. 5J5021	File No.	
Analysis No.	Rev. No.	Sheet No.	





CYGNA
Calculation Sheet
Project CUPERTINO CITY HALL
Prepared By:
Date
Subject
Checked By:
Date
System
Job No. 5J5021
File No.
Analysis No.
Rev. No.
Sheet No. HW-3
A
(E) 16B31
(N) A.B WHERE APPLICABLE SEE (E)
B
(E) REINF
(E) TRIMS
C
48"
1" CLR
NEW CHORD AT EXISTING JAMB
ALTERNATE #2

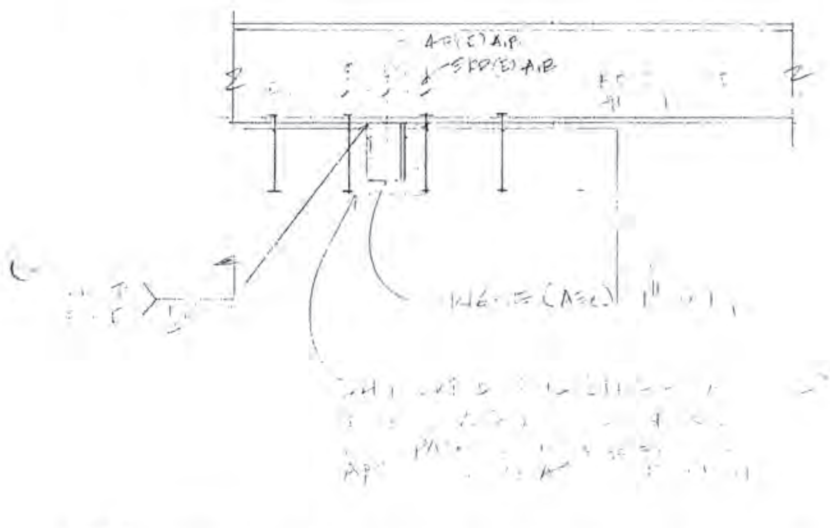


CYGNA
Calculation Sheet
Project CUPERTINO CITY HALL
Prepared By:
Date
Subject
Checked By:
Date
System
Job No. 5J5021
File No.
Analysis No.
Rev. No.
Sheet No. HW-4
(E) 16B31
(N) A.B WHERE APPLICABLE SEE (E)
SECT A
ALTERNATE #2
(E) #8 TRIMS
NEW #9 (40Y)
CHIP & ROUGHEN EXISTING CONC SURFACE TO EXPOSE (E) AGGREGATES TO ABOUT 1/4" CLEAN CONTACT SURFACE PRIOR TO APPLYING (N) CONC.
PLAN B
ALTERNATE #2
DRILL 1 1/2" φ HOLE INTO (E)
FILL HOLE
PLAN C
ALTERNATE #2

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By:	Date
Subject:		Checked By: EAH	Date: MAY 8?
System:		Job No.: S15021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: HW-5	



4 NEW SHEAR KEY AT ... EXISTING WALL

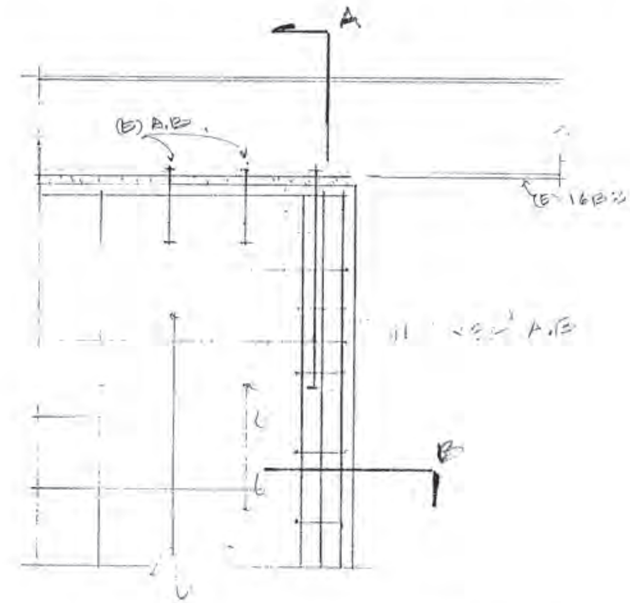
ALTERNATE #2

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By:	Date:
Subject:		Checked By: EAH	Date: MAY 8?
System:		Job No.: S15021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: HW-6	



5 NEW A.B. AT WALL SAME

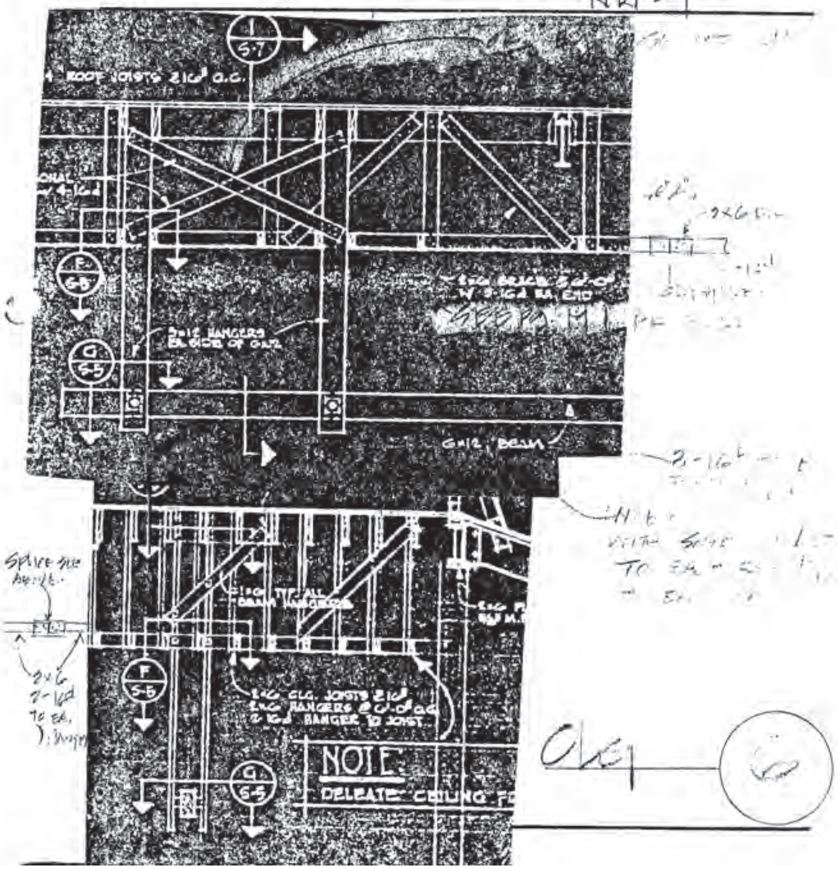
ALTERNATE #2

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date:	
Subject:	Checked By:	Date: MAY 86	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: NH-7	



VERIFICATION

OF

EXISTING CONDITION.

AGAINST AS ASSUMED &

AS READ FROM EXISTING

DRAWINGS.

Strength Evaluation of Existing Structures

Sec. 2620. (a) Notations.

a = maximum deflection under test load of member relative to a line joining the ends of the span, or of the free end of cantilever relative to its support, inches.

D = dead loads, or related internal moments and forces.

h = overall thickness of member, inches.

l_t = span of member under load test (shorter span of flat slabs and of slabs supported on four sides). Span of member, except as provided in Section 2620 (e) 9, is distance between centers of supports or clear distance between supports plus depth of member, whichever is smaller, inches.

L = live loads, or related internal moments and forces.

(b) Strength Evaluation—General. If doubt develops concerning the safety of a structure or member, the building official may order a structural strength investigation by analyses or by means of load tests, or by a combination of analyses and load tests.

(c) Analytical Investigations—General. If strength evaluation is by analysis, a thorough field investigation shall be made of dimensions and details of members, properties of materials and other pertinent conditions of the structure as actually built.

Analyses based on investigation required by this subsection shall satisfy the building official that the load factors meet requirements and intent of this code. See Section 2620 (g).

(d) Load Tests—General. If strength evaluation is by load tests, a qualified engineer acceptable to the building official shall control such tests.

A load test shall not be made until that portion of the structure to be subject to load is at least 56 days old. When the owner of the structure, the contractor and all involved parties mutually agree, the test may be made at an earlier age.

When only a portion of the structure is to be load tested, the questionable portion shall be load tested in such a manner as to adequately test the suspected source of weakness.

426 UBC 1985

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By:	Date: 9/27/8
Subject: PROBLEM & SOLUTION		Checked By:	Date: MAY 96
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: V-1	

VERIFICATION

Ⓑ DENOTES EXISTING SHEET EDGE NAILING 10d @ 6" o.c.

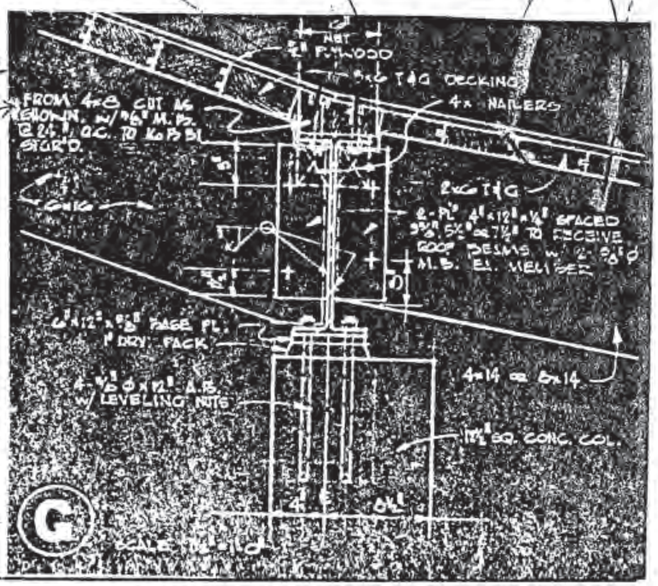
VERIFY

Ⓑ DENOTES EXISTING SHEET EDGE NAILING 8d (HALF LENGTH) @ 6" o.c. + ~~NEW 8d (½ LENGTH) @ 6" o.c. STAGGER WITH (E)~~

VERIFY THE NAILING

VERIFY

See pg L39



CYGNA

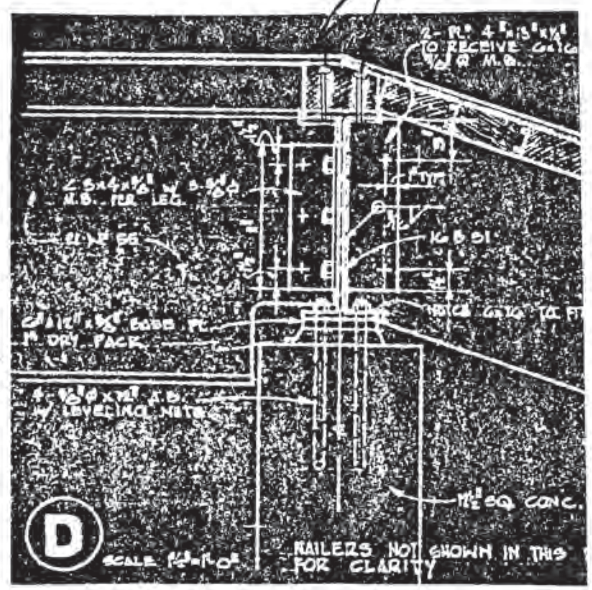
Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By:	Date:
Subject:		Checked By:	Date: MAY 96
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: V-2	

VERIFICATION

VERIFY

Ⓑ NAILING

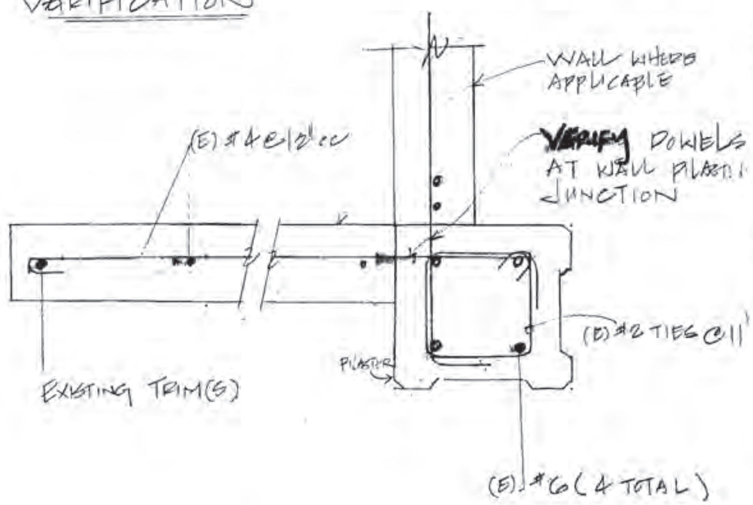


CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By:	Date
Subject		Checked By: EAH	Date: MAY/86
System		Job No.: SJ5021	File No.
Analysis No.	Rev. No.	Sheet No.: V-3	

VERIFICATION



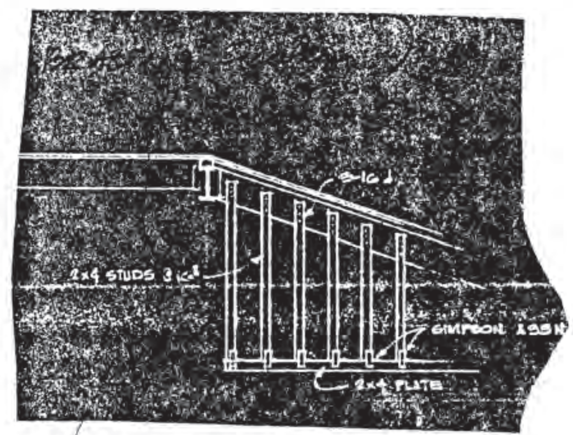
X ANCHORAGE OF HORIZ...

1006 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By:	Date	
Subject	Checked By: EAH	Date: MAY 86	
System	Job No.: SJ5021	File No.	
Analysis No.	Sheet No.: V-4		



VERIFY CLG BRACING

1006 00

MISC — ① WIND CHECK @ COVERED WALKWAY ← NOT PART OF THIS CONTRACT.

② CLG BRACING ← ROUGH CHECK

③ CHECK PARAPET

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: [illegible]	Date:
Subject:		Checked By: EAH	Date: MAY 86
System:		Job No.: 5J5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: M 1	

CHECK CEILING BRACING

$F_p = Z\,I\,C_p\,W_p = 0.45\,W_p = 2$ PSF

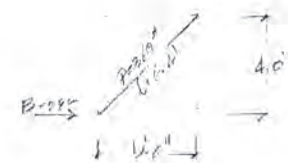
(Z = 1.0, I = 1.5, C_p = 0.3)

W_p: ④ + ⑥ = 4.5 PSF > 4.0 PSF MIN.

(EXISTING DRAWING IS NOT CLEAR)

ROUGH TRIBUTARY AREA PER BRACE = 24' × 6' = 144 ft²

∴ P = 2 psf × 144 ft² = 288 #



$\frac{KL}{d} = \frac{1.0 \times 6.4 \times 12}{1.5} = 51 > 50$ [illegible]

$F_c' = \frac{0.3(E)}{\left(\frac{KL}{d}\right)^2} = 173$ psi

$f_c = \frac{369^{\#}}{1.5 \times 5.5} = 45$ psi

$3\text{-}16^d = 107^{\#} \times 1.33 \times 3 = 426^{\#} > [illegible]$

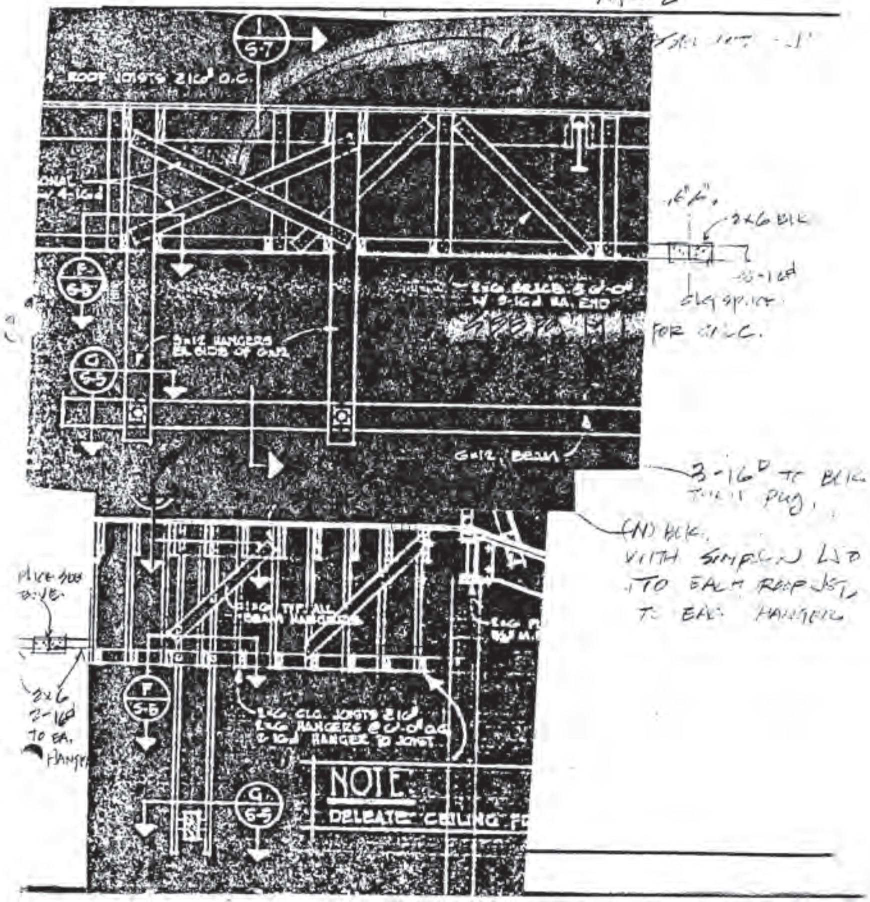
$2\text{-}16^d = 107 \times 1.33 \times 2 = [illegible]$

1000.00

CYGNA

Calculation Sheet

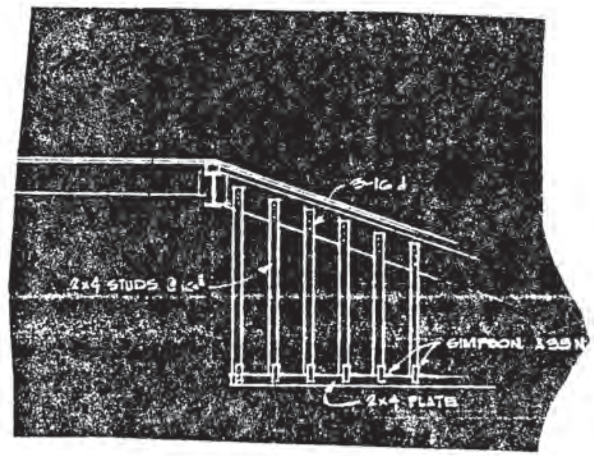
Project	Cupertino City Hall	Prepared By:	Jy	Date	
Subject		Checked By:	EAH	Date	May 86
System		Job No.	SJ5021	File No.	
Analysis No.	Rev. No.	Sheet No.	M-2		



CYGNA

Calculation Sheet

Project	Cupertino City Hall	Prepared By:	Jy	Date	
Subject		Checked By:	EAH	Date	May 86
System		Job No.	SJ5021	File No.	
Analysis No.	Rev. No.	Sheet No.	M3		



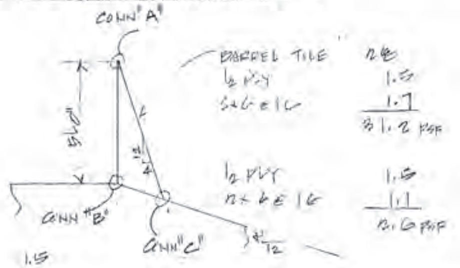
1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: JCY	Date:
Subject:		Checked By: EAH	Date: MAY 85
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: M4	

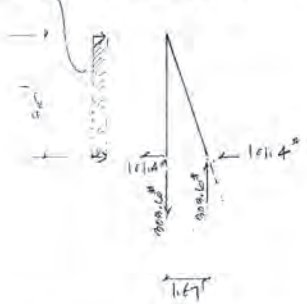
MECHANICAL ENCLOSURE AT ROOF



BARREL TILE	28
½ PLY	1.5
2x6 @ 16	1.7
	31.2 PSF
½ PLY	1.5
2x4 @ 16	1.1
	2.6 PSF

$F_p = Z\,I\,C_p\,W_p = 1.2\,W_p = 1.2(2.6 + 31.2) = 40.56$ PSF
(Z = 1.0, I = 1.5, C_p = 0.8)

$W_p = 40.56\,\text{PSF} \times 1' = 40.56^{\#/'}$

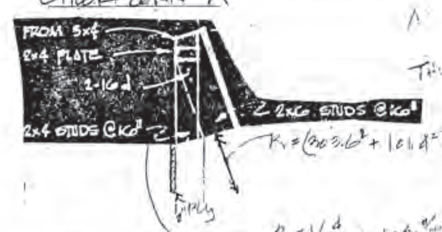


CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: JCY	Date:
Subject:		Checked By: EAH	Date: MAY 85
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: M5	

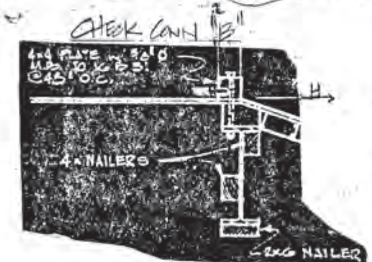
CHECK CONN "A"



$R = (303.6^2 + 101.4^2)^{1/2} = 320.0^{\#/'} \times 1.33' = 425.7^{\#}$ (16" o.c.)

2-16d = 108#/nail × 2 nails × 1.33 = 287.3#

CHECK CONN "B"



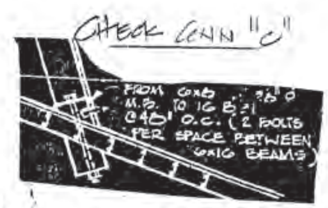
SHEAR = 101.4 #/' × 4' = 405.6# VS 1.26K

TEN = 303.6 × 4 = 1214.4# VS 8.1K

SHEAR: ⅝"Φ IN 4x (SINGLE SHEAR B/W 4x & DIAPH) = 950# × 1.33 = 1.26K

TEN = 6.1K/BOLT × 1.33 = 8.1K

CHECK CONN "C"



CALC SIM TO CONN "B"

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: [illegible]	Date:
Subject:		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.:	

CHECK WIND UPLIFT @ COVERED WALKWAYS

DEAD = ① + ② + ③ + ④ = 37 PSF × 9/13 = 24.7 PSF

WIND = $C_e C_q q_s I$ = 33.5 PSF

NET UPLIFT = 33.5 − 24.7 = 8.8 PSF

ω_{up} = 8.8 PSF × 6' = 53 #/'

R = 53 #/' × 12' × 6' / 8' = 477 # ← SIMPSON [illegible] ABOVE EA. SIDE 2 × 235 # × 1.33 = 625 # OK

L = 53 #/' × 12' − R = 159 # ← (E) [illegible] G/SE [illegible]

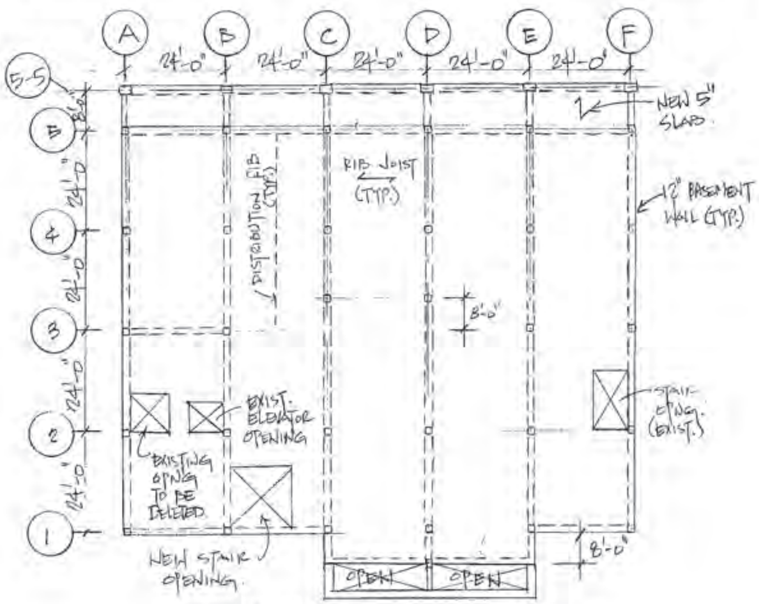
1005-00

City Hall Remodel

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: FLOOR FRAMING PLAN		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: B8	



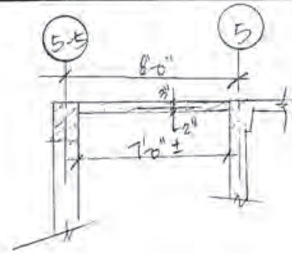
FIRST FLOOR FRAMING PLAN

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 4/86
Subject: NEW SLAB @ NORTH SIDE OF BLDG.		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: B9	



$W_D = (5''/12)(150\,pcf)(1) = 63\ \#/'$

$W_L = 100\,psf(1) = 100\ \#/'$

$W_u = 1.4 W_D + 1.7 W_L = 258\ \#/'$

$d = 3''$, $b = 12''$,

$F = bd^2/12000 = 0.009$

$M_u = \frac{1}{8} W_u l^2 = \frac{1}{8}(.258)(7)^2$

$= 1.580^{k}$

$k_u = M_u/F = 176$

→ $\rho = 0.0053$

$A_s = 0.191\ in^2/'$

$A_{s(reqd)} = \frac{M(12000)}{.89d(40,000)} = .18 < .19$ o.k.

$A_{s(temp)} = 0.0020(12'' \times 5'')$

$= 0.12\ in^2/' < 0.191\ in^2/'$

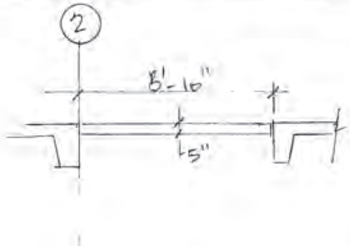
USE #4 @ 12" O.C. E.W.

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: LHo	Date:
Subject: NEW SLAB @ EXIST. STAIR OPNG.	Checked By: EAH	Date: MAY 86
System:	Job No.: SJ 5021	File No.:
Analysis No.: Rev. No.:	Sheet No.: B10	



$W_D = (\frac{5}{12})(150\,pcf)(1') = 63^{\#}/'$

$W_L = 50\,psf(1') = 50$

$W_u = 1.4 W_D + 1.7 W_L = 173^{\#}/'$

$d = 3"$, $b = 12"$, $h = 5"$

$F = bd^2/12000 = 0.009$

$M_u = \frac{1}{8} W_u l^2 = 2.536^{1k}$

$K_u = M_u/F = 282$ ✓

→ $\rho = 0.0083$

$A_s = 0.30\ in^2/'$

USE #4 @ 8" o.c.

$A_{s(TEMP)} = 0.002\ (12" \times 5")$

$= 0.12\ in^2/'$

USE #4 @ 12" o.c ✓

$A_{s\,req} = 12000 M / .378d (40000)$ = .28 < .3 o.k.

1206.00

CYGNA

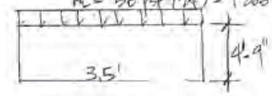
Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: LHo	Date: 4/86
Subject: SPANDREL BEAM ABOVE NEW DOOR	Checked By: EAH	Date: MAY 86
System:	Job No.: SJ 5021	File No.:
Analysis No.: Rev. No.:	Sheet No.: B11	

$W_D = \{75\,psf(4.75') = 356^{\#}/'$; $67\,psf(24') = 1608^{\#}/'\}$

$W_L = 50\,psf(24') = 1200^{\#}/'$

$W_u = 4.79^{k}/'$



$M = \frac{1}{12} W_u l^2 = 4.89^{1k}$

$b = 6"$, $d \doteq 50"$, $h = 57"$

$F = 1.25$

$K_u = 3.91$ (MINIMAL)

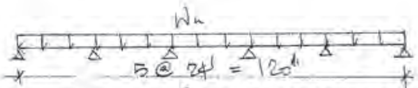
∴ SPANDREL BEAM IS ADEQUATE.

1206.00

CYGNA

Calculation Sheet

Project	CUPERTINO CITY HALL	Prepared By:	LHo	Date	4/86
Subject	NEW CORRIDOR FRAMING	Checked By:	EAH	Date	MAY 86
System		Job No.	SJ5021	File No.	
Analysis No.	Rev. No.	Sheet No.	B12		



$W_D = 150 pcf [(\frac{8}{12})(5) + (1.5')(2.5')] = 875 \#/'$

$W_L = 100 PSF (5') = 500 \#/'$

$W_u = 1.4 W_D + 1.7 W_L = 2075 \#/'$

$+M_{MAX} = 0.078 W_u L^2 = 93.23'^k$

$-M_{MAX} = 0.105 W_u L^2 = 125.50'^k$ ✓

$V_{MAX} = \frac{13}{38} W_u L$ ✓ $= 30.14^k$

TRY 18" x 30" BEAM, b = 18", d = 26", h = 30"

$F = bd^2/12000 = 1.014$

$+K_u = 92 \rightarrow \rho = 0.0018(4/3) = 0.0024$

$A_s = 1.123$ in²

USE 4 - #5.

$-K_u = 124$ ✓ $\rightarrow \rho = 0.0021(4/3) = 0.0028$

$A_s = 1.31$ in² ✗

USE 5 - #5 = 1.55

$A_s = \frac{M}{.89d(60{,}000)} = 1.085$

$v_u = 30.14^k / 0.85(18")(26")$
$= 76$ psi $> \frac{1}{2}(2\sqrt{f'_c}) = 55$ psi

$\rho = .0023(4/3) = .0031$

$A = .0031(18)(26) = 1.4$

$1.45 < 1.55$

o.k.

$S_{max} \leq A_s f_y / 50 b_w = 0.40(40000)/50(18)$
$\leq 17.8"$
$\leq d/2 = 13"$

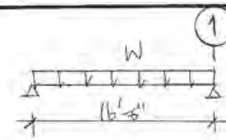
USE #4 STIRRUPS @ 12" O.C.

1006.00

CYGNA

Calculation Sheet

Project	CUPERTINO CITY HALL	Prepared By:	LHo	Date	4/86
Subject	NEW STAIRWELL BEAM	Checked By:	EAH	Date	MAY 86
System		Job No.	SJ5021	File No.	
Analysis No.	Rev. No.	Sheet No.	B13		



$W_D = 67 PSF (5') = 335 \#/'$

$W_L = 50 PSF (5') = 250 \#/'$

$W_{D+L} = 585 \#/'$

✓

$M_{MAX} = \frac{1}{8} W l^2 = 18.72'^k$

$V_{MAX} = \frac{1}{2} W l = 4.68^k$

$\delta_{ALL} = L/240 = 0.80"$

$S_{REQ'D} = 18.72(12)/21.6 = 10.4$ in³

$A_{REQ'D} = 4.68 / 14.4 = 0.33$ in²

$I_{REQ'D} = 5Wl^4/384E\Delta_{ALL} = 37.2$ in⁴

TRY W12x22

$A = 3.26$ in²
$S = 25.4$ in³
$I = 156$ in⁴

$f_b = 8.84$ ksi
$F_{b1} = 8.69$ ksi
$F_{b3} = 4.80$ ksi

$F_b \simeq f_b$ OK
$f_v = 1.5$ ksi OK
$\delta_{D+L} = 0.191$ in $= L/1007$ OK

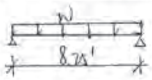
1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 5/86
Subject: NEW STAIRWELL BEAM		Checked By: EAH	Date: MAY 86
System:		Job No: SJ 5021	File No:
Analysis No:	Rev. No:	Sheet No: B14.1	

STAIRWELL LANDING



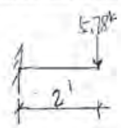
$W_D = 75 psf (8') = 600 \#/'$
$W_L = 100 psf (8') = 800$
$W_T = W_D + W_L = 1400 \#/'$

$M_{max} = 11.91^{'k}$
$V_{max} = 5.78^k$

TRY W12×22
A = 3.20
S = 25.4
I = 156

$f_v = 1.80$ ksi
$f_b = 5.63$ ksi
$\delta_{DTL} = 0.0323'' = L/3069$ } OK

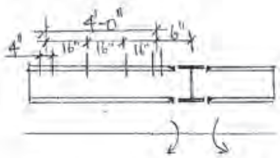
STAIRWELL SUPPORT



$M_{max} = 11.56^{'k}$

TRY W12×22
S = 25.4
I = 156

$f_b = 5.48$ ksi
$\delta_{DTL} = 0.019'' = L/1254$ } OK



ANCHORAGE OF BACK SPAN BEAM:
USE ½"Φ WEDGE ANCHORS
MIN. EDGE DISTANCE = 6d = 3"
MIN. BOLT SPACING = 12d = 6" } USE ½ CAPACITY.

$M = 11.56^{'k} = P(4')$
$\rightarrow P = 2.89^k$
$= 0.72^k$/anchor

PULLOUT CAPACITY $= \frac{5.9}{4} \times \frac{1}{2} = 0.74^k$ OK

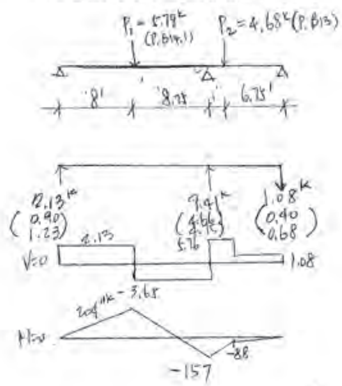
1906 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 5/86
Subject: NEW STAIRWELL GIRDER		Checked By: EAH	Date: MAY 86
System:		Job No: SJ 5021	File No:
Analysis No:	Rev. No:	Sheet No: B14.2	

STAIRWELL GIRDER



TRY W12×26
A = 2.81
S = 33.4
I = 204

$f_v = 5.76/2.81$
$= 2.05$ ksi OK

$= 204/33.4$
$= 6.11$ ksi OK

CHECK BEARING STRESS ON WALL

$P_u = 1.4(4.66) + 1.7(4.75) = 14.6^k$

@ WALL $f_{brg} = 14600 / 0.7(6'' \times 4'' \times 4)$ ← 4" WALL THICKNESS
$= 217$ psi $< 0.7 \times 0.85 \times 3$ ksi $= 1.785$ ksi OK

BEARING STRESS FOR STEEL

$f_{brg} = 9.41^k/(4'' \times 6'') = 0.392$ ksi $< 0.35 f'_c = 1.05$ ksi OK

1008 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: LHo	Date: 5/86	
Subject: NEW RAMP @ SOUTH SIDE	Checked By: EAH	Date: MAY 86	
System:	Job No.: SJ 5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: B15	

DESIGN NEW SLAB

$W_D = \frac{5''}{12}(150\ PCF)(1') = 62.5\ \#/'$
$W_L = \quad = 100\ \#/'$
$W_u = 1.4 W_D + 1.7 W_L = 258\ \#/'$

SPAN = 8.0' ±
$M_u = \frac{1}{8} W_u l^2 = 2.064\ ^{1k}/'$
$F = (12'')(3'')^2/12000 = 0.009$
$K_n = M_u/F = 229$
$\rho = 0.0068$
$A_s = \rho b d = 0.245\ in^2$

$A_{STEMP} = 0.0020(12 \times 5) = 0.12\ in$

USE #4 @ 9" O.C.

USE #4 @ 12" O.C.

CHECK ADDITIONAL SOIL PRESSURE TO 12" RETAINING WALL

$P = (62.5 + 100)\#/' \times \frac{14.5'}{2} = 1178\#$
$P_{EXIST.} = 150\ PCF(1' \times 12') + 150(1.33' \times 1') = 2000\#$
$P_{TOTAL} = 1178 + 2000 = 3178\#$
$P_{BRG.} = 3178/1.33' \times 1'$
$= 2384\ PSF. < 3000\ PSF$ OK.

$P_{D(BRG)} = [1178(\frac{62.5}{162.5}) + 2000]/1.33$
$= 1840\ PSF < 2000\ PSF$ OK.

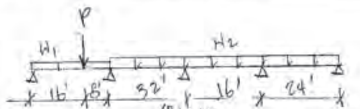
✓

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: LHo	Date: 5/86	
Subject: EXISTING FLOOR FRAMING	Checked By: EAH	Date: MAY 86	
System:	Job No.: SJ 5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: B16	

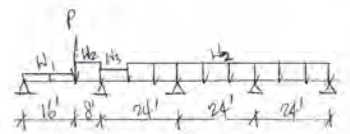


LINE C

$W_{1D} = 67\ PSF(5' + 12') = 1139\ \#/'$
$W_{1L} = 50\ PSF(5' + 12') = 850$
} $W_u = 3.04\ ^k/'$

$W_{2D} = 67\ PSF(24') = 1608$
$W_{2L} = 50\ PSF(24') = 1200$
} $W_u = 4.29\ ^k/'$

$P_D = (P. B13 \& B14) = -0.40^k$
$P_L = \quad = -0.68^k$
} $P_u = 1.72^k$



LINE B

$W_{1D} = 67\ PSF(5' + 12') = 1139\ \#/'$
$W_{1L} = 50\ PSF(5' + 12') = 850\ \#/'$
} $W_u = 3.04\ ^k/'$

$W_{2D} = 67\ (24') = 1608$
$W_{2L} = 50\ (24') = 1200$
} $W_u = 4.29\ ^k/'$

$W_{3D} = 67\ (12') = 804$
$W_{3L} = 50\ (12') = 600$
} $W_u = 2.15\ ^k/'$

$P_D = (P. B13 \& B14) = +0.90^k$
$P_L = \quad = +1.23^k$
} $P_u = 3.35^k$

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 5/86
Subject: EXISTING FLOOR FRAMING		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ 5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: B17	

BEAM CAPACITIES (LINE B)

+VE STEEL $b = 16"$, $d = 33"$, $M_n' = A_s \cdot a_n \cdot d\ (0.90)$

3-#8, $A_s = 2.37\ in^2$, $\rho = 0.0045$, $a_n = 4.26$, $M_n' = 300^{1k}$
4-#8, = 3.16, = 0.0060, = 4.18, = 392
1-#8+2-#11, = 3.91, = 0.0074, = 4.10, = 476

−VE STEEL $b = 16"$, $d = 33"$, $M_n = A_s \cdot a_n \cdot d$

1-#8+3-#11 $A_s = 5.47$, $\rho = 0.0104$, $a_n = 3.94$, $M_n' = 642^{1k}$
1-#8+2-#11 = 3.91, = 0.0074, = 4.10, = 476
2-#8+2-#11 = 4.70, = 0.0089, = 4.02, = 562

BEAM CAPACITIES (LINE C)

+VE STEEL

2-#11, $A_s = 3.12$, $\rho = 0.0059$, $a_n = 4.18$, $M_n' = 387$
2-#8+2-#11, = 4.70, = 0.0089, = 4.02, = 624

−VE STEEL

2-#11, $A_s = 3.12$, $\rho = 0.0059$, $a_n = 4.18$, $M_n' = 387$
2-#8+2-#11, = 4.70, = 0.0089, = 4.02, = 562
1-#8+4-#11, = 7.03, = 0.0133, = 3.79, = 791
2-#8+4-#11, = 7.82, = 0.0148, = 3.71, = 861

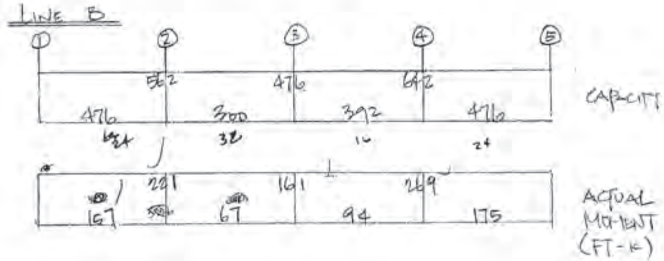
1008.00

CYGNA

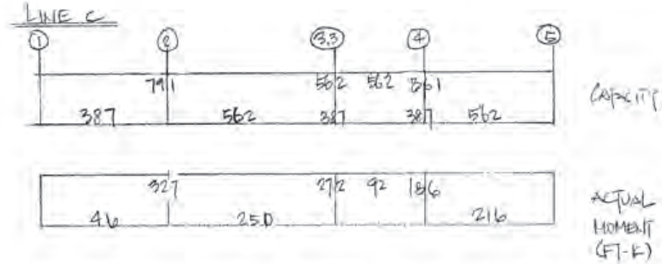
Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 5/86
Subject: EXISTING FLOOR FRAMING		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ 5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: B18	

LINE B



LINE C



IN COMPARING ACTUAL MOMENTS AND ALLOWABLE CAPACITIES, THE EXISTING GIRDERS ARE MORE THAN ADEQUATE.

1008.00

P. B19.1

```
****************************************
*                                      *
*          CONTINUOUS BEAM             *
*            VERSION 1.1               *
*                                      *
****************************************
```

1. PROGRAM IS SET UP TO HANDLE SYSTEMS WITH UP TO 16 SPANS
2. INPUT CW EXTERNAL JOINT MOMENTS AS POSITIVE MOMENTS
3. INPUT DOWNWARD EXTERNAL CONCENTRATED LOADS AS POSITIVE LOADS
4. POSITIVE OUTPUT END MOMENTS ARE CW MOMENTS
5. POSITIVE OUTPUT JOINT ROTATIONS ARE CW ROTATIONS

PROJECT NAME: CUPERTINO CITY HALL
BEAM I.D.: LINE C

P. B19.2

SPAN 'C'

INPUT DATA

MODULUS OF ELASTICITY = 1 KSI

BEAM DATA

SPAN NUMBER	LENGTH (FEET)	GIRDER I (IN^4)
1	24	1
2	32	1
3	16	1
4	24	1

LOADS INPUT FOR LOAD CASE 1 (D + L)

UNIFORM LOADS

SPAN NUMBER	UNIFORM LOAD IN KIPS PER FOOT
1	3.04
2	4.29
3	4.29
4	4.29

CONCENTRATED LOADS

*** SPAN NUMBER 1 ***

LOAD NUMBER 1
LOAD = -1.72 KIPS
DIST. FROM LEFT= 16 FEET

*** SPAN NUMBER 2 ***

NO CONC. LOADS THIS SPAN

*** SPAN NUMBER 3 ***

NO CONC. LOADS THIS SPAN

*** SPAN NUMBER 4 ***

NO CONC. LOADS THIS SPAN

JOINT LOADS

```
************************
SOLUTION FOR LOAD CASE  1
************************

 ************************
 .NT ROTATIONS
************************

    JOINT  1  ROT = 395.724  RAD.

    JOINT  2  ROT = 922.8985  RAD.

    JOINT  3  ROT = -1214.084  RAD.

    JOINT  4  ROT = 984.321  RAD.

    JOINT  5  ROT = -1727.68  RAD.


************************
MEMBER FORCES
************************

*** SPAN   1  ***

    LEFT MOMENT  =  0  FT-KIPS

    APPROX. MAXIMUM SPAN MOMENT = -46.40773  FOOT KIPS

    RIGHT MOMENT =  326.5979  FT-KIPS

    LEFT SHEAR =  22.29842  KIPS

    RIGHT SHEAR =  48.94158  KIPS

*** SPAN   2  ***

    LEFT MOMENT  = -326.5979  FT-KIPS

    APPROX. MAXIMUM SPAN MOMENT = -249.8207  FOOT KIPS

    RIGHT MOMENT =  272.0007  FT-KIPS

    LEFT SHEAR =  70.34616  KIPS

    RIGHT SHEAR =  66.93384  KIPS

*** SPAN   3  ***

    LEFT MOMENT  = -272.0007  FT-KIPS

    APPROX. MAXIMUM SPAN MOMENT =  91.64028  FOOT KIPS

    RIGHT MOMENT =  185.8398  FT-KIPS

    LEFT SHEAR =  39.70506  KIPS

    RIGHT SHEAR =  28.93494  KIPS

*** SPAN   4  ***
```

P. B19.3

```
    APPROX. MAXIMUM SPAN MOMENT = -215.9601  FOOT KIPS

    RIGHT MOMENT =  0  FT-KIPS

    LEFT SHEAR =  59.22333  KIPS

    RIGHT SHEAR =  43.73667  KIPS

************************************************************
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P. B 19.4

P. B20.1

CONTINUOUS BEAM
VERSION 1.1

1. PROGRAM IS SET UP TO HANDLE SYSTEMS WITH UP TO 16 SPANS
2. INPUT CW EXTERNAL JOINT MOMENTS AS POSITIVE MOMENTS
3. INPUT DOWNWARD EXTERNAL CONCENTRATED LOADS AS POSITIVE LOADS
4. POSITIVE OUTPUT END MOMENTS ARE CW MOMENTS
5. POSITIVE OUTPUT JOINT ROTATIONS ARE CW ROTATIONS

PROJECT NAME: CUPERTINO CITY HALL
BEAM I.D.: LINE B

P. B20.2

INPUT DATA

ULUS OF ELASTICITY = 1 KSI

SPAN "B"

BEAM DATA

SPAN NUMBER	LENGTH (FEET)	GIRDER I (IN^4)
1	24	1
2	24	1
3	24	1
4	24	1

LOADS INPUT FOR LOAD CASE 1 (D + L)

UNIFORM LOADS

SPAN NUMBER	UNIFORM LOAD IN KIPS PER FOOT
1	3.46
2	3.58
3	4.29
4	4.29

CONCENTRATED LOADS

*** SPAN NUMBER 1 ***

LOAD NUMBER 1
LOAD = 3.35 KIPS
DIST. FROM LEFT= 16 FEET

*** SPAN NUMBER 2 ***

NO CONC. LOADS THIS SPAN

*** SPAN NUMBER 3 ***

NO CONC. LOADS THIS SPAN

*** SPAN NUMBER 4 ***

NO CONC. LOADS THIS SPAN

JOINT LOADS

P. B 20.3

```
****************************************************************
SOLUTION FOR LOAD CASE  1
****************************************************************

 :*********************
 .NT ROTATIONS
************************

    JOINT  1  ROT =  1205.716  RAD.

    JOINT  2  ROT = -347.0044  RAD.

    JOINT  3  ROT =  108.4888  RAD.

    JOINT  4  ROT =  322.0089  RAD.

    JOINT  5  ROT = -1396.524  RAD.


************************
MEMBER FORCES
************************

*** SPAN   1  ***

    LEFT MOMENT  =  0  FT-KIPS

    APPROX. MAXIMUM SPAN MOMENT = -156.67  FOOT KIPS

    RIGHT MOMENT =  220.6333  FT-KIPS

    LEFT SHEAR =  33.44361  KIPS

    RIGHT SHEAR =  52.94639  KIPS

*** SPAN   2  ***

    LEFT MOMENT  = -220.6334  FT-KIPS

    APPROX. MAXIMUM SPAN MOMENT = -66.9411  FOOT KIPS

    RIGHT MOMENT =  161.0045  FT-KIPS

    LEFT SHEAR =  45.44454  KIPS

    RIGHT SHEAR =  40.47547  KIPS

*** SPAN   3  ***

    LEFT MOMENT  = -161.0045  FT-KIPS

    APPROX. MAXIMUM SPAN MOMENT = -94.06334  FOOT KIPS

    RIGHT MOMENT =  268.6289  FT-KIPS

    LEFT SHEAR =  46.99565  KIPS

    RIGHT SHEAR =  55.96435  KIPS

*** SPAN   4  ***
```

P. B 20.4

```
    APPROX. MAXIMUM SPAN MOMENT = -174.5656  FOOT KIPS

    RIGHT MOMENT =  0  FT-KIPS

    LEFT SHEAR =  62.67287  KIPS

    RIGHT SHEAR =  40.28713  KIPS

****************************************************************
```

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: LHo	Date: 4/86	
Subject: COLUMNS @ GRID 5-5	Checked By: EAH	Date: MAY 86	
System:	Job No. S/5021	File No.	
Analysis No.	Rev. No.	Sheet No. C 1	

TYPICAL COLUMNS

ROOF : DEAD LOAD = 70 PSF (24' × 8') (Pg 7) = 13440#
LIVE LOAD = 20 PSF (24' × 8') = 3840#

FLOOR : DEAD LOAD = 150 PCF ($\frac{5}{12}$)(5')(24') + 150 PCF (1.5×2.5)(24') + 150 PCF (1'×1'×13.5') = 23035#
LIVE LOAD = 100 PSF (24' × 5') = 12000#

$P_u = 1.4 P_D + 1.7 P_L$
$= 1.4(13.44 + 23.025) + 1.7(3.84 + 12.0)$
$= 78.0^k$

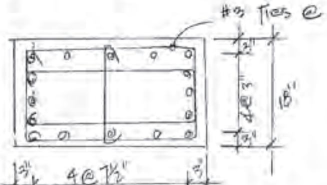
FOR 18" × 36" NEW COLUMN

$\phi P_n / A_g = 78.0^k / (18 \times 36) = 0.120$; $e/h = 0.10$ } $\rho_g = 0.01 = \rho_{min}$

$A_s = 0.01(18 \times 36) = 6.48\ in^2$.

USE 16-#6 $A_s = 7.04\ in^2$

#3 TIES @ ≤ 16(.75) = 12" ← GOVERNS
≤ 48(.375) = 18"
≤ 18"



1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: LHo	Date: 4/86	
Subject: FOOTINGS @ GRID 5-5	Checked By: EAH	Date: MAY 86	
System:	Job No. S/5021	File No.	
Analysis No.	Rev. No.	Sheet No. F 1	

TYPICAL FOOTINGS

ALLOW. SOIL PRESSURE : DL 2 KSF; D+L 3 KSF; D+L+Q 4 KSF

$P_{D+L} = 52.31^k$
$P_u = 78.0^k$

$A_{REQ'D} = 52.31^k / 3\ KSF = 17.44$ SQ.FT.

TRY 5' × 3.5' FOOTING

$q_u = 78.0^k/(5 \times 3.5') = 4.46$ KSF

TRY d = 11", h = 15"

a) PUNCHING SHEAR

$b_o = 2[(36+d)+(18+d)] = 152"$
$v_{u1} = 78^k(1000)/0.85(152)(11) = 55$ PSI $< 4\sqrt{f'_c}$ OK

b) BEAM SHEAR

$V_{u2} = 4.46\ KSF(\frac{1}{12})(3') = 1.12^k$
$v_{u2} = 1.12(1000)/0.85(36" \times 11") = 3.3$ PSI $\ll 2\sqrt{f'_c}$ OK

c) LONGITUDINAL REINF.

$M_u = 4.46\ KSF(1')(1')(0.5') = 2.23^{k'}/'$
$F = bd^2/12000 = 12(11)^2/12000 = 0.121$
$K_u = 18.4 \rightarrow \rho = 0.0005$
USE $\rho_{min} = 0.0020(12" \times 15") = 0.36\ in^2/' \times 3 = 1.08\ in^2$

USE 4-#5

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHO	Date: 4/86
Subject: FOOTINGS @ GRID 5-5		Checked By: EAH	Date: MAY 86
System:		Job No. S15021	File No.
Analysis No.	Rev. No.	Sheet No. F2	

(d) TRANSVERSE DIRECTION
SAME AS FOR LONGITUDINAL DIRECTION.
$A_s = 0.36 \, in^2/' \times 5' = 1.8 \, in^2$

USE 6 - #5

✓

1006 (0)

PAGE: F3
PROJECT:CUPERTINO CITY HALL
SUBJECT:RETAINING WALL DESIGN
BY : LHO DATE:

R E T A I N I N G W A L L D E S I G N

LOCATION : GRID 5-5

>DESIGN DATA :

Soil Bearing Press =	3000 psf	Ftg/Soil Friction =	0.30
Active Fluid Press =	45 pcf	Footing:	
Passive Pressure =	260 pcf	f'c - Concrete =	3,000 psi
Soil Density =	110 pcf	Fy - Reinforcement =	60,000 psi

WALL LOADING CONDITIONS :

> Slope of Backfill = (horiz:vert 0=Level)	0 :1	Design Fluid Pressure = (Corrected for Slope)	45.0 pcf
> Surcharge over Toe =	0 psf	> Surcharge over Heel =	0 psf
> Axial Load on Stem =	0 plf	> Soil Ht. over Toe =	12 in
Wall Ht above Soil =	0 ft	> Wind/Seismic Load =	0 psf
> Adjacent Ftg Load = (parallel to wall)	0 plf	> Spread Ftg ? Y=1 N=0 ->	0
		> Ftg. Dist. from Wall =	0 ft
> Width of Footing =	0 ft	> Depth of Bearing Below Soil @ Rear F.O.W. =	0 ft

WALL & FOOTING GEOMETRY :

> RETAINED HEIGHT = (above T.O.F.)	13.5 ft	> Footing Thickness =	24 in
		> Key Depth =	16 in
> Toe Width =	1 ft	> Key Width =	12 in
Stem Width =	1.00 ft	> Toe/Key Dist. =	12 ft
> Heel Width =	4.5 ft		
FOOTING WIDTH =	6.50 ft		

OVERALL STABILITY SUMMARY :

SOIL PRESSURE @ TOE = 6,842 psf : 3,000 = Allowable
SOIL PRESSURE @ HEEL = 0 psf

FACTOR OF SAFETY : Overturning = 1.51
FACTOR OF SAFETY : Sliding = 1.06

ONE-WAY SHEAR AT TOE SIDE OF STEM = < 1 >
ONE-WAY SHEAR AT HEEL SIDE OF STEM = < 1 >

NOTE: 1 = OK, 0 = NO GOOD

(C) 1985 ENERCALC Retaining Wall Design 08-Apr-86

```
                                        PAGE: F4
                    PROJECT:CUPERTINO CITY HALL
                    SUBJECT:RETAINING WALL
                            DESIGN
                         BY : LHD       DATE:____________
--------------------------------------------------------------------------

  STABILITY CHECK :
  -----------------
> NOTE: Should 1/3 of Active Pressure be Used as Vertical
        Pressure at rear face of stem?  Y=1 , N = 0     ---->>     1
                                                                  ---
  OVERTURNING MOMENT = 27,929  ft-#
   RESISTING MOMENT  = 42,286  ft-#        MAX. LATERAL FORCE = 5,406 #

   FACTOR OF SAFETY : Overturning -->   1.51

  SLIDING CHECK :
  ---------------
   Max. Lateral Force = 5,406  #   > Ht. of Soil to Neglect =     0 in
   Max. Resis.  Force = 5,710  #     Passive  Pressure       = 2,441 #
   F. S  : Sliding    =  1.06        Friction Pressure       = 3,269 #
                                   NG !   Min. F.S. of 1.5 Per UBC 2308(b)
  SOIL PRESSURE :
  ---------------
    Eccentricity from CL    =   2.01 ft      Kern Distance  =  1.08 ft

                              UN-FACTORED       FACTORED
                              -----------       --------
      >  SOIL PRESSURE @ TOE   =     6,842 psf      11,631 psf

      >  SOIL PRESSURE @ HEEL  =         0 psf           0 psf

  TOE DESIGN :
  ------------
   Upward Moment      =  5,104 ft-#   Mu : DESIGN MOMENT    =  4,824 ft-#
   Downward Moment    =    280 ft-#     * Loads Factored Later *

   % Steel Minimum    = 0.0012             d = Thk-3"          =  21.00 in
   % Steel Actual     = 0.0012             'm'  =              =  23.53
   As : Required      =  0.302 in^2/ft     R-u                 =  12.15 psi

  One Way Shear:                     Try: #4 @   7.5 "   #7 @  23.5 "
   Fv =  2*(f'c^.5)   =  109.5 psi        #5 @  12.5 "   #8 @  31.5 "
   Actual Shear       =   37.7 psi        #6 @  17.5 "   #9 @  39.5 "

  HEEL DESIGN :
  -------------
>  Neglect Upward Soil Pressure?  Y=1 N=0 -->       0
                                                   ---
   Mu''=Downward Mom. =25,302 ft-#      Mu: DESIGN MOMENT  = 25,302 ft-#
   Mu' =Upward Moment =      0 ft-#     * Loads Factored Later *

   % Steel Minimum    = 0.0012             d = Thk-3"          =  21.00
   % Steel Actual     = 0.0014             'm'  =              =  23.53
   As : Required      =  0.361  in^2/f     R-u                 =  63.75 psi

  One Way Shear:                     Try: #4 @   6.50 "   #7 @ 19.50 "
   Fv =  2*(f'c^.5)   = 109.54 psi        #5 @  10.50 "   #8 @ 26.50 "
   Actual Shear       =   0.00 psi        #6 @  14.50 "   #9 @ 33.50 "

V2.2 (C) 1985 ENERCALC      Retaining Wall Design               08-Apr-86
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                                        PAGE: F5
                    PROJECT:CUPERTINO CITY HALL
                    SUBJECT:RETAINING WALL
                            DESIGN
                         BY : LHD       DATE:____________
--------------------------------------------------------------------------

  TOP STEM SECTION DESIGN :
  -------------------------                                        ---
> WALL MATERIAL :  CONCRETE = 1, MASONRY = 2 :  -->>        1  <<--
                                                           ---
> f'c  Concrete      =  3,000 psi  > Fy : Reinforcing     =   60,000 psi
> f'm  Masonry       =  1,350 psi    fs : Masonry design  =   24,000 psi

  Top Ht above TOF   = 13.50 ft      Total Lat. Pressure   =   4,101 #
> Bot Ht above TOF   =     0 ft      Maximum M:service     = 18,453 ft-#
> Wall Thickness     =    12 in      'd' for design        =    8.50 in
> REBAR SIZE :       #     7         Rebar Area Req'd      =    0.97 in^2
> Center=1 , Edge=2 ->     2
> Solid Grout?       >     0         REQ'D SPACING         =    8.00 in
> Inspected ? Y=1 N=0>     0
  Bond Length Req'd  =    NA in      Masonry :           Actual   Allow.
  Allow. Unit Shear  = 109.5 psi        f'm       =         NA      NA psi
  Actual Unit Shear  =  68.3 psi        fs        =         NA      NA psi

2 (C) 1985 ENERCALC        Retaining Wall Design                08-Apr-86
```

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ 5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: L 100	

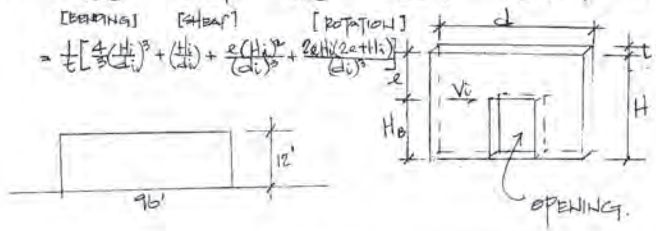
WALL LINE NO. Ⓐ & F

$E = 3\times10^6$ psi
$G = 1.2\times10^6$ psi
$P = 10^6$ LBS.

$$\Delta = \frac{PH_i^3}{3EI} + \frac{1.2PH_i}{AG} + \frac{MH_i^2}{2EI} + \frac{PH_i}{EI}\left(\ell + \frac{H_i}{2}\right)(\ell)$$

[BENDING] [SHEAR] [ROTATION]

$$= \frac{1}{t}\left[\frac{4}{3}\left(\frac{H_i}{d_i}\right)^3 + \left(\frac{H_i}{d_i}\right) + \frac{\ell(H_i)^2}{(d_i)^3} + \frac{2\ell H_i(2\ell+H_i)}{(d_i)^3}\right]$$



PIER	Hi (FT.)	di (FT.)	ℓ (FT.)	t (IN.)	Δ BENDING	Δ SHEAR	Δ ROTATION	Δ TOTAL	R=1/Δ TOT.
	12	96	–	12"	0.000217	0.010417	–	0.010634	94.04

1006 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ 5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: L 101	

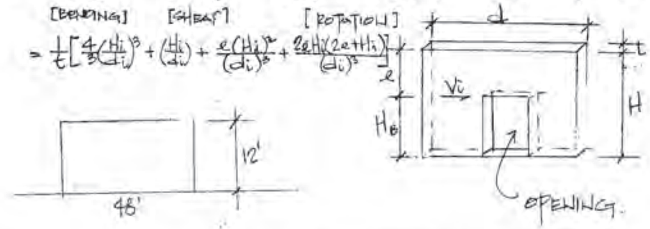
WALL LINE NO. ①

$E = 3\times10^6$ psi
$G = 1.2\times10^6$ psi
$P = 10^6$ LBS.

$$\Delta = \frac{PH_i^3}{3EI} + \frac{1.2PH_i}{AG} + \frac{MH_i^2}{2EI} + \frac{PH_i}{EI}\left(\ell + \frac{H_i}{2}\right)(\ell)$$

[BENDING] [SHEAR] [ROTATION]

$$= \frac{1}{t}\left[\frac{4}{3}\left(\frac{H_i}{d_i}\right)^3 + \left(\frac{H_i}{d_i}\right) + \frac{\ell(H_i)^2}{(d_i)^3} + \frac{2\ell H_i(2\ell+H_i)}{(d_i)^3}\right]$$



PIER	Hi (FT.)	di (FT.)	ℓ (FT.)	t (IN.)	Δ BENDING	Δ SHEAR	Δ ROTATION	Δ TOTAL	R=1/Δ TOT.
	12	48	–	12	0.001736	0.020833	–	0.022569	44.31

1006 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ 5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: L102	

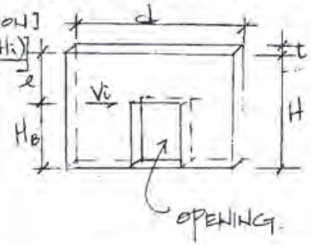
WALL LINE No. ①

E = 3×10[6] psi
G = 1.2×10[6] psi
P = 10[6] LBS.

$$\Delta = \frac{PH_i^3}{3EI} + \frac{1.2PH_i}{AG} + \frac{MH_i^2}{2EI} + \frac{PH_i}{EI}\left(\ell + \frac{H_i}{2}\right)(\ell)$$

[BENDING] [SHEAR] [ROTATION]

$$= \frac{1}{t}\left[\frac{4}{3}\left(\frac{H_i}{d_i}\right)^3 + \left(\frac{H_i}{d_i}\right) + \frac{\ell(H_i)^2}{(d_i)^3} + \frac{2\ell H_i(2\ell+H_i)}{(d_i)^3}\right]$$



PIER	Hi (FT.)	di (FT.)	ℓ (FT.)	t (IN.)	Δ BENDING	Δ SHEAR	Δ ROTATION	Δ TOTAL	R=1/ΔTOT.
	12	24	–	12	0.013889	0.041667	–	0.055556	18.00

1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ 5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: L103	

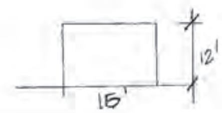
WALL LINE No. Ⓒ & E

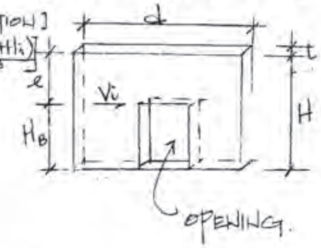
E = 3×10[6] psi
G = 1.2×10[6] psi
P = 10[6] LBS.

$$\Delta = \frac{PH_i^3}{3EI} + \frac{1.2PH_i}{AG} + \frac{MH_i^2}{2EI} + \frac{PH_i}{EI}\left(\ell + \frac{H_i}{2}\right)(\ell)$$

[BENDING] [SHEAR] [ROTATION]

$$= \frac{1}{t}\left[\frac{4}{3}\left(\frac{H_i}{d_i}\right)^3 + \left(\frac{H_i}{d_i}\right) + \frac{\ell(H_i)^2}{(d_i)^3} + \frac{2\ell H_i(2\ell+H_i)}{(d_i)^3}\right]$$





PIER	Hi (FT.)	di (FT.)	ℓ (FT.)	t (IN.)	Δ BENDING	Δ SHEAR	Δ ROTATION	Δ TOTAL	R=1/ΔTOT.
	12	16	–	12	0.046875	0.062500	–	0.109375	9.14 ✓

1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System		Job No.: SJ 5021	File No.
Analysis No.	Rev. No.	Sheet No.: L104	

WALL LINE NO. ⑤

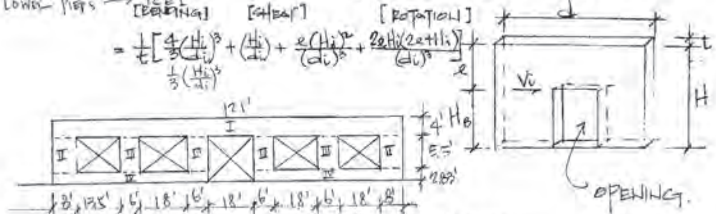
$E = 3\times10^6$ psi
$G = 1.2\times10^6$ psi
$P = 10^6$ lbs.

$$\Delta = \frac{PH_i^3}{3EI} + \frac{1.2PH_i}{AG} + \frac{MH_i^2}{2EI} + \frac{PH_i}{EI}\left(\ell + \frac{H_i}{2}\right)(\ell)$$

Lower Piers → $\frac{PH_i^3}{12EI}$ [BENDING] [SHEAR] [ROTATION]

$$= \frac{1}{t}\left[\frac{4}{3}\left(\frac{H_i}{d_i}\right)^3 + \left(\frac{H_i}{d_i}\right) + \frac{\ell(H_i)^2}{(d_i)^3} + \frac{12\ell H_i(2\ell+H_i)}{(d_i)^3}\right]$$

$\frac{1}{3}\left(\frac{H_i}{d_i}\right)^3$



$t^* = 12" + 6"$ GUNITE

PIER	H_i (FT)	d_i (FT.)	ℓ (FT.)	t^* (IN.)	$\Delta_{BENDING}$	Δ_{SHEAR}	$\Delta_{ROTATION}$	Δ_{TOTAL}	$R = 1/\Delta_{TOT.}$
I	4.0	121	0	18	0.000003	0.001837	—	0.001839	543.71
II	5.5	8	4	18	0.006018	0.038194	0.077582	0.121799	8.21
III	5.5	6	4	18	0.014264	0.050926	0.183899	0.249089	4.01
IV	2.83	51.5	9.5	18	0.000003	0.003053	0.000508	0.003564	280.56

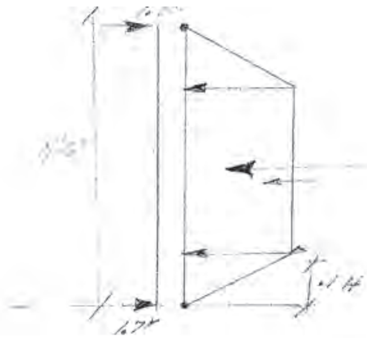
(P. L104.1)

$$\Delta_T = 0.001839 + \frac{1}{2(8.21)+4(4.01)} + 0.000996 + \frac{1}{2(280.56)}$$

$= 0.035924$

$R = 1/\Delta_T = 28.23$

1006.03



$e = P H_i / 12$

$M = 4.7 \times \frac{11.5}{2}$

$\overline{M} = 9.3 - .030 - 3. = 6.31'$

$6.31^{k'}$ vs 4.4K'

$\frac{11.5}{2} - 1.15$

= 5½

4.6'

$11.5^2 \times \frac{.045}{2} = 2.98 \times .67$

1.99

4.14

#6 @ 16" O.C.

.31

.23

1 1/8" plywd — 4 lbs/ft
3/4 @16" — 8
Misc 3
Finish 1
16 lbs/ft + 25% LL = 21 lbs/ft

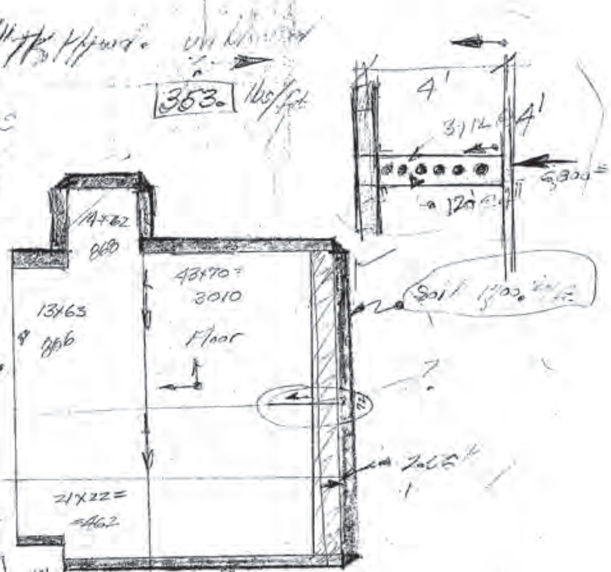
*.14x16 = 10k / 70 (150 lbs/ft)

Soil w/o Earthquake 1700 ... 26/70 = 380 lbs/ft
150.
1,850.

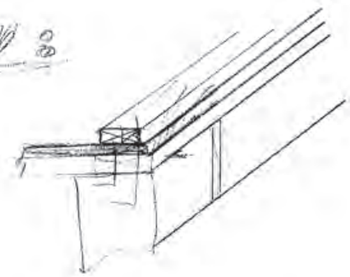
Strength 1 1/8" T&G Plywd. ...
353 lbs/ft

1) No Cross ties
2) No B... ...
3) Higher Soils loadings

A)
3010.
462.
3472.
...3472x41 = ...
868
808.
1674 x 15
3472
51,462
= 17086.
3... 5/6.

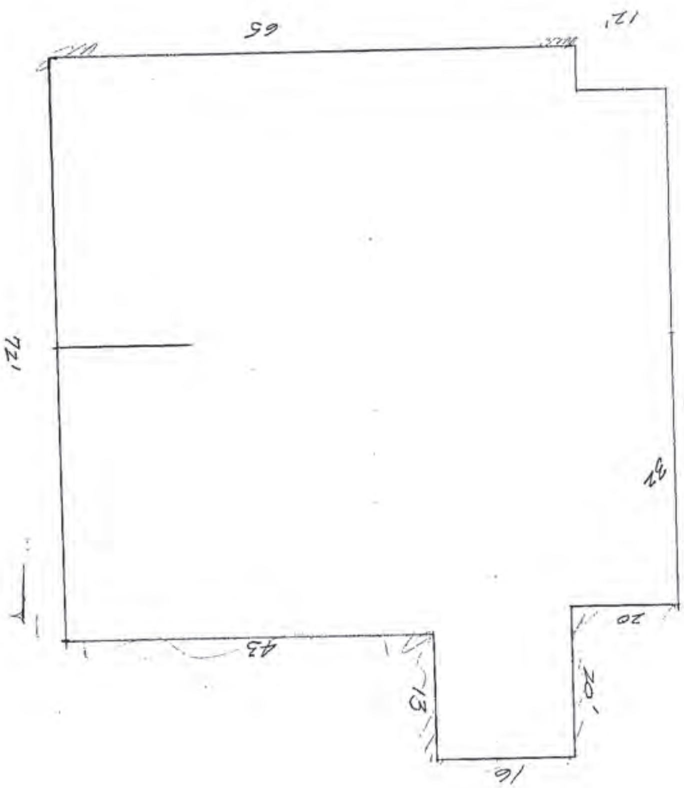


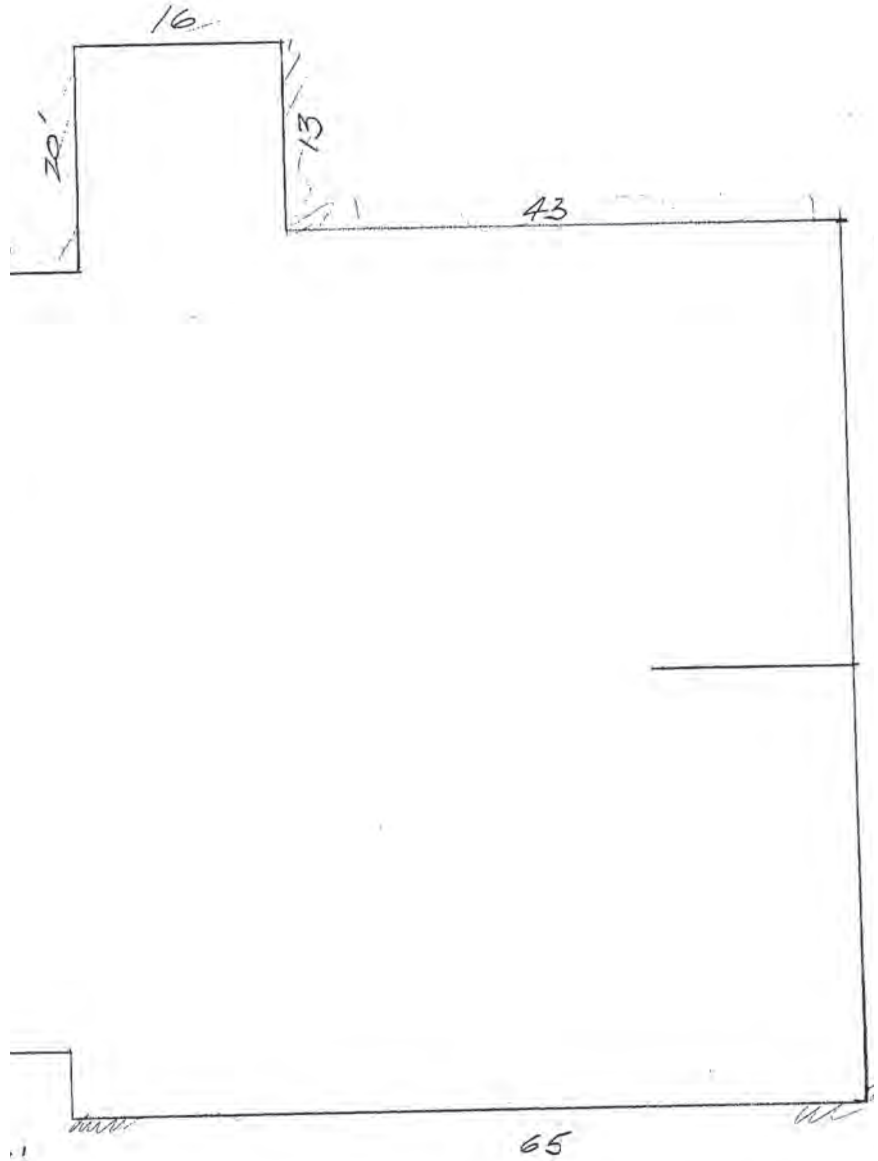
Wall

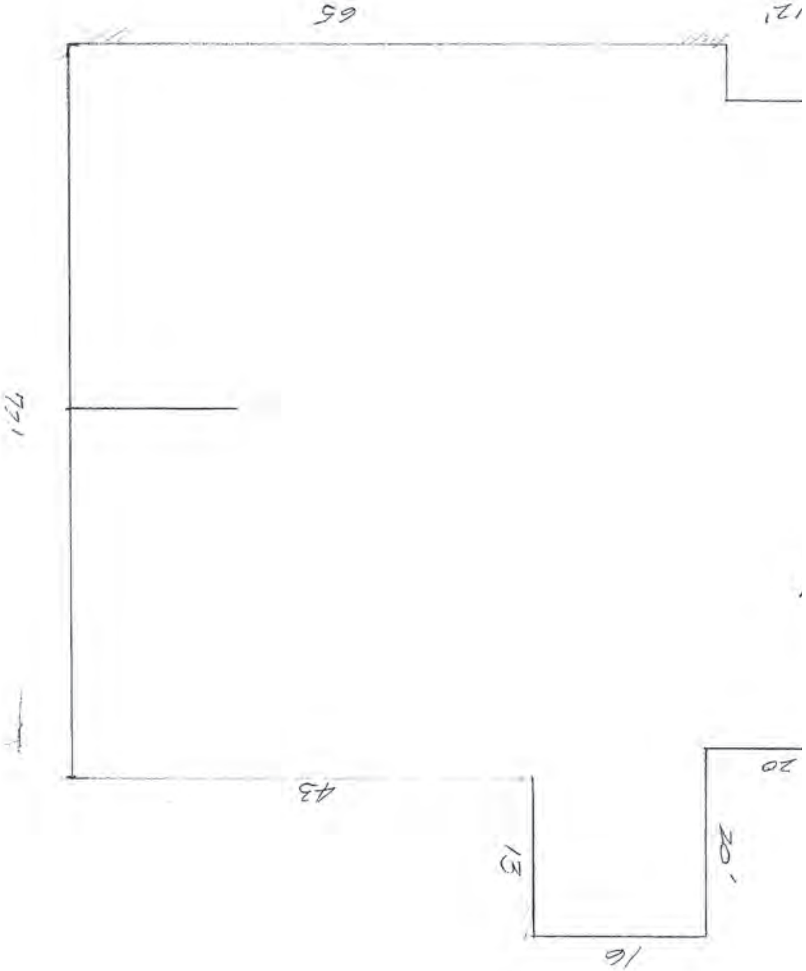


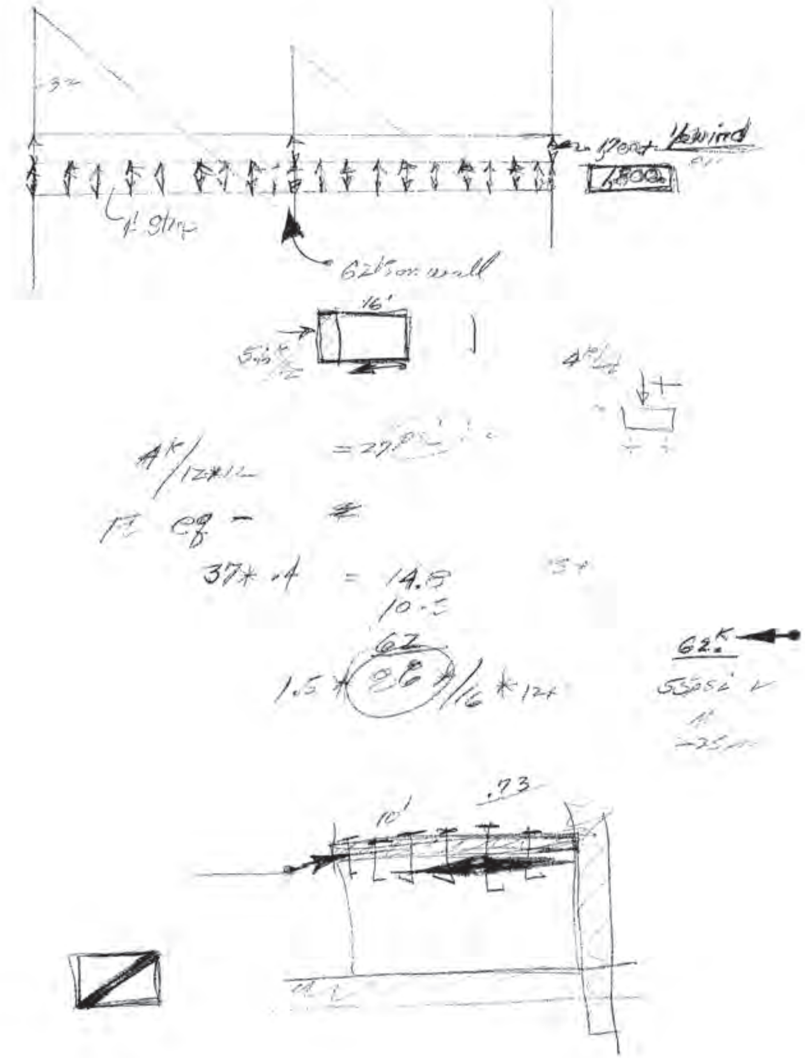
Shear down wall =
across wall = 1.2k

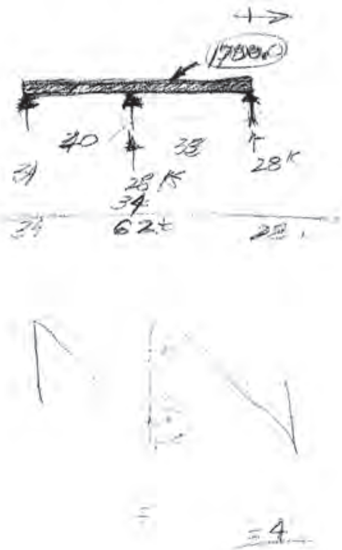
1 1/8" T&G ...
12d@4" ~ 640 lbs/ft ?




16
20'
13
43
65




62k on wall
16'
37 * .4 = 14.8
62k
10'
.73

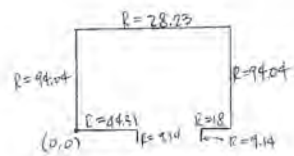


CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHO	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System:		Job No: SJ 5021	File No:
Analysis No.	Rev. No.	Sheet No. L105	

LOCATE CENTER OF RIGIDITY



$\bar{X}_R = [94.04(0) + 94.04(120) + 9.14(48 + 96)] / (94.04 + 9.14)(2)$
$= 61.06'$

$\bar{Y}_R = [(44.31 + 18)(0) + 28.23(96')] / (28.23 + 44.31 + 18)$
$= 29.93'$

$\bar{X}_M = 60.00'$

$\bar{Y}_M = 48.0'$

$e_{MIN.} = 0.05 (120')$
$= 6.0'$

$e_x = 61.06' - 60' = 1.06' < 6.0'$ USE $e = 6.0'$ ✓

$e_y = 48.0' - 29.93' = 18.07' > 6.0'$ USE $e = 18.07'$ ✓

3006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: LHo	Date: 3/86	
Subject: FLAT LOADS FOR QUAKE ANALYSIS	Checked By: EAH	Date: MAY 86	
System:	Job No.: SJ5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L106	

FIRST FLOOR FRAMING:

TYP. JOIST, J1 : $W = [\frac{1}{2} \times (6+8)(12'') + 3 \times 36''] \times 150pcf / (144 in^2 \times 3)$
$= 67$ PLF

TYP. DISTRIBUTION RIB : $W = [\frac{1}{2} \times (6+8)(12'')](150 pcf) / 144 in^2$
$= 87.5$ PLF

TYPICAL CONC. GIRDER : $W = [(16 \times 33) + (3 \times 12 \times 2)](150 pcf)/144 in^2$
$= 625$ PLF.

TYPICAL COLUMN : $W = [(12.5 \times 12.5)(150 pcf)/144] \times 11\frac{1}{2}$
$= 895$ # @

TYPICAL PER. WALL : $W = (1' \times 11\frac{1}{2})(150 pcf)$
$= 825$ #/'

TOTAL FLOOR WEIGHT $= 67$ PLF$(121' \times 97') + 87.5$ PLF$(95' \times 5 + 30')$
$+ 625$ PLF$(95' \times 4) + 895$#(30)
$+ 825$#/'$(120' + 96')(2)$
$= 1451.32^k$

$V = ZIcSKW$
$= (1.0)(1.5)(.14)(1.33)(1451.32^k)$
$= 0.297 W$
$= 405.4^k$

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL	Prepared By: LHo	Date: 3/86	
Subject: LATERAL	Checked By: EAH	Date: MAY 86	
System:	Job No.: SJ 5021	File No.:	
Analysis No.:	Rev. No.:	Sheet No.: L107	

DESIGN EQ. LOADS

I. N-S DIRECTION

$V = 42.5^k \times 2$ (P. L2) $+ 405.4^k$ (P. L106) $= 490.4^k$
$T = V \times 6' = 2943.^{\prime k}$

II. E-W DIRECTION

$V = 57.0^k \times 2$ (P. L2) $+ 405.4$ (P. L106) $= 519.4^k$
$T = V \times 18.07' = 9385^{\prime k}$

1008.00

CYGNA

Calculation Sheet

Project	CUPERTINO CITY HALL	Prepared By:	LHo	Date	3/86
Subject	LATERAL	Checked By:	EAH	Date	MAY 86
System		Job No.	SJ 5021	File No.	
Analysis No.	Rev. No:	Sheet No.	L108		

DISTRIBUTION OF EQ. FORCES TO SHEAR WALLS
(EQ. IN N-S DIRECTION)

(P. L107)
F = 490.4 KIPS
T = 2943 K-FT.

→ $\bar{X}_R$ = 61.06', $\bar{Y}_R$ = 24.55' (P. L105)

LINE	R	d_i (FT.)	Rd_i	Rd_i^2	V_F (K) $= F \cdot \frac{R}{\Sigma R}$	V_M (K) $= T \cdot \frac{Rd_i}{\Sigma R d_i^2}$	V_T (KIPS)
A	94.04	61.06	5742.08	350612	223.5	19.4	242.9
C	9.14	13.06	119.37	1559	21.7	0.4	22.1
E	9.14	34.94	319.35	11158	21.7	—	21.7
F	94.04	58.94	5542.72	326688	223.5	—	223.5
Σ=	206.36						
1AC	44.31	24.55	1087.81	26706	—	3.7	3.7
1EF	18.00	24.55	441.90	10849	—	1.5	1.5
5	28.23	71.45	2017.0	144117 871689	—	6.8	6.8

1008 00

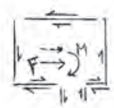
CYGNA

Calculation Sheet

Project	CUPERTINO CITY HALL	Prepared By:	LHo	Date	3/86
Subject	LATERAL	Checked By:	EAH	Date	MAY 86
System		Job No.	SJ 5021	File No.	
Analysis No.	Rev. No.	Sheet No.	L109		

DISTRIBUTION OF EQ. FORCES TO SHEAR WALLS
(EQ. IN E-W DIRECTION)

F = 519.4 KIPS
T = 9385 K-FT.



LINE	R	d_i (FT.)	Rd_i	Rd_i^2	V_F (K) $= F \cdot \frac{R}{\Sigma R}$	V_M (K) $= T \cdot \frac{Rd_i}{\Sigma R d_i^2}$	V_T (KIPS)
1AC	44.31	24.55	1087.81	26706	254.2	—	254.2
1EF	18.00	24.55	441.90	10849	103.3	—	103.3
5	28.23	71.45	1529.74	144117	161.9	16.5	178.4
Σ=	90.54						
A	94.04	61.06	5742.08	350612	—	61.8	61.8
C	9.14	13.06	119.37	1559	—	1.3	1.3
E	9.14	34.94	319.35	11158	—	3.4	3.4
F	94.04	58.94	5542.72	326688 871689	—	59.7	59.7

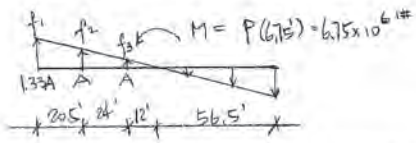
1008 00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ 5021	File No.:
Analysis No.:	Rev. No.:	Sheet No.: L104.1	

COMPRESSION OF PIERS :



$f_1 = K_T(56.5)$
$f_2 = K_T(36)$
$f_3 = K_T(12)$

RESISTING MOMENT $= [(f_1 \cdot \frac{4A}{3})(56.5) + (f_2 A)(36) + (f_3 A)(12)](2)$
$= 11393\ K_T \cdot A$

SET $11393\ K_T A = 6.75 \times 10^6$
$A K_T = 592.5$
$K_T = 592.5/A$

$R_1 = f_1(4A/3) = 44635^{\#}$
$R_2 = f_2 A = 21330^{\#}$
$R_3 = f_3 A = 7110^{\#}$

Δh = CHANGE IN LENGTH OF PIER II.
$= R_1 h / A E$
$\Delta h \cdot E = R_1 h / A_1$
$\theta = 2 \cdot \Delta h / 113'$
$E\theta = [R_1 h / A_1 ; \Delta h][\Delta h / 56.5]$
$= R_1 h / 56.5 A_1$
$= \frac{(44635)(5.5' \times 12'')}{56.5(12'' \times 8 \times 12)}$
$= 45.3$ psi
$\theta = 45.3 / 3 \times 10^6$
$= 1.51 \times 10^{-5}$
$\Delta F = \theta H = 1.51 \times 10^{-5} (66'')$
$= 0.000996$

1008.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ 5021	File No.:
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CHECK WALL STRESSES UNDER EQ. LOADS

I WALL A/F

(P. L108)
$V_{MAX} = 2 \times 242.9^k / 0.85(0.8 \times 96' \times 12 \times 12'')$
$= 52$ psi $< 2\sqrt{2500} = 100$ psi OK.

II. WALL C/E

(P. L108)
$V_{MAX} = 2 \times 22.1^k / 0.85(0.8 \times 15' \times 12 \times 12'')$
$= 30$ psi < 100 psi OK

III. WALL 1 A-C

(P. L109)
$V_{MAX} = 2 \times 254.2^k / 0.85(0.8 \times 48' \times 12 \times 12'')$
$= 108$ psi > 100 psi
$V_S = 8$ psi < 50 psi (MIN.)
$S_{REQ'D} = \frac{A_V f_y}{50\ b w} = \frac{0.31 in^2 \times 40000 psi}{50 psi \times 12''}$
$= 20.7'' < 10''$ (PROVIDED)

#5 @ 10" O.C. OK.

1008.00

CYGNA

Calculation Sheet

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IV. WALL 1 & F

$V_{MAX} = 2 * 103.3^k$ (P. L109) $/ 0.85 (0.8 \times 24' \times 12 \times 12")$
$= 88$ psi $<$ 100 psi OK

V. WALL 5

$V_{MAX} = 2 * 178.4^k$ (P. L109)
$= 356.8^k$

PIER I. : $V_{MAX} = 356.8^k / 0.85 (0.8 \times 21' \times 12 \times 18")$
$= 20$ psi $<$ 100 psi OK

PIER II : $V_{MAX} = 356.8^k (\frac{8.21}{2 \times 8.21 + 4 \times 4.01}) / 0.85 (0.8 \times 8' \times 12 \times 18")$ [90.3^k]
$= 77$ psi $<$ 100 psi OK

PIER III : $V_{MAX} = 356.8^k (\frac{4.01}{2 \times 8.21 + 4 \times 4.01}) / 0.85 (0.8 \times 6' \times 12 \times 18)$ [44.1^k]
$= 50$ psi $<$ 100 psi OK

PIER IV : $V_{MAX} = 356.8^k / 0.85 (0.8 \times 51.5' \times 12 \times 18)(2)$
$= 24$ psi $<$ 100 psi OK

1008.00

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Calculation Sheet

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CHECK SPANDREL BEAM REINF REQ'D @ NEW OPNGS

- MAX. WIDTH OF OPNG. = 18'-0"
- SPANDREL BEAM SUPPORTS ITS OWN WEIGHT ONLY

$W_D = (.15 \text{ kcf})(\frac{18"}{12})(4') = 0.90^{k/'}$
$W_u = 1.4 (0.9^{k/'}) = 1.26^{k/'}$

$M_{MAX} = \frac{1}{12} W_u l^2 = \frac{1}{12}(1.26)(18)^2$
$= 34.0^{1k}$

$d \doteq 48 - 8" = 40"$, $b = 18"$, $A_s = 0.31 \times 2 = 0.62 \text{ in}^2$
$a = A_s f_y / 0.85 f'_c b$
$= 0.62 (40000) / 0.85 (2500)(18)$
$= 0.65"$
$M_n = A_s f_y (d - \frac{a}{2}) = 82^{1k}$
$M_u = 0.9 M_n = 73.8^{1k} > 34^{1k}$ OK

$\rho_{min} = .005$

$V_u = W_u L/2 = 1.26(18')/2 = 11.34^k$
$v_u = 11340^\# / 0.85 (18" \times 40") = 19$ psi $\ll \frac{1}{2}[2\sqrt{2500}] = 50$ psi

NO SHEAR REINF. IS REQ'D

1008.00

CYGNA

Calculation Sheet

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CHECK TRIM STEEL REQUIRED AT PIERS II & III

PIER II : V = 90.3^k (P. L111)

OTM = 90.3^k x 5.5' = 496.7^{1k}

RM = ⅔ x (14.75' x 4' + 8' x 5.5')(1.5')(.150 kcf)(4') = 69.5^{1k}

T = C = (496.7 − 69.5)/0.9(8')
= 59.3^k

As (req'd) = 59.3^k / 0.6(40 ksi)(1.33)
= 1.86 in²

@ CORNER : 4-#6 + ½(2-#6) → As = 2.2 in² OK

@ OPNG : 2-#6 → As = 0.88 in²

ADD 3 #6 TO EDGE OF OPNG @ 6" O.C.

1006.00

CYGNA

Calculation Sheet

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PIER III : V = 44.1^k

OTM = 44.1^k x 5' = 220.5^{1k}

RM = ⅔ x (21.75' x 4' + 5.5' x 6')(1.5')(.150 kcf)(3') = 60.8^{1k}

T = C = (220.5 − 60.8) / 5'
= 32.0^k

As (req'd) = (32.0^k) / 0.6(40 ksi)(1.33)
= 1.0 in²

@ OPNG : 1-#6 → As = 0.44 in²

ADD 1-#7 TO EDGE OF OPENING

1006.00

CYGNA

Calculation Sheet

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CHECK SHEAR FRICTION @ LINE 5 FOOTING

$V_u = \left(\frac{356.8^k}{2}\right)/51.5'$ (P. L111)

$= 3.46^{k}/'$

$V_n = \mu A_{vf} f_y$ $\mu = 1.0,$ $f_y = 40$ ksi

$A_{vf} = V_n / f_y$

$= 3.46/40$

$= 0.09$ in^2/' $\ll$ 0.44 in^2 PROVIDED (#6 @ 12")

OK

CHECK WALL SLIDING IN N-S DIRECTION

$V_n = 409.4^k$ (P. L107) [490.k]

TOTAL DEAD LOAD $= 1451.32^k + (111.7 + 125.3 + 33.4)(2)$ (P. L106) (P. L2)

$+ (91.6 + 94.1 + 16.7)(2)$

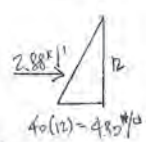
$+ (.15\ kcf)[1' \times 12.33' \times 440' + 1' \times 2' \times 440']$ (WALL) (FTG)

$= 3342.7^k$

DIFFERENTIAL SOIL PRESSURE

$= 2.88^{k}/'(12')(1.7)$

$= 592.4^k$



TOTAL SLIDING FORCE $= 592.4 + 242.9 = 835.3^k$ (V_E P. L108)

TOTAL SLIDING RESISTANCE $= \mu(3342.7^k)$

$= 0.35(3342.7^k) = 1170^k > 835.3^k$

OK

1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHo	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System:		Job No.: SJ5021	File No.:
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CHECK OVERTURNING OF WALL @ LINE A/F

$OTM = 242.9^k(13.33')$ (P. L108)

$= 3238^{\prime k}$

$RM = [53\ psf(12' + 6') + 67\ psf(12') + 0.15\ kcf(12.33')(1')$ (P. G6) (P. L106, L1)

$+ .15(1' \times 2')](97')(97'/2)(0.75)$

$= 3.91^{k}/'(97')^2(0.375)$

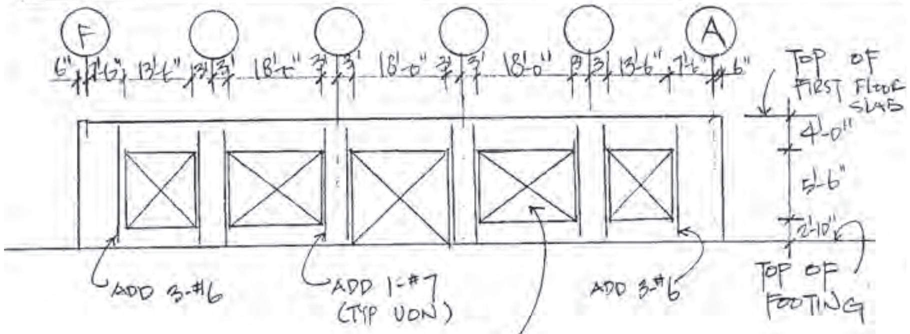
$= 13787^{\prime k} > 3238^{\prime k}$ OK

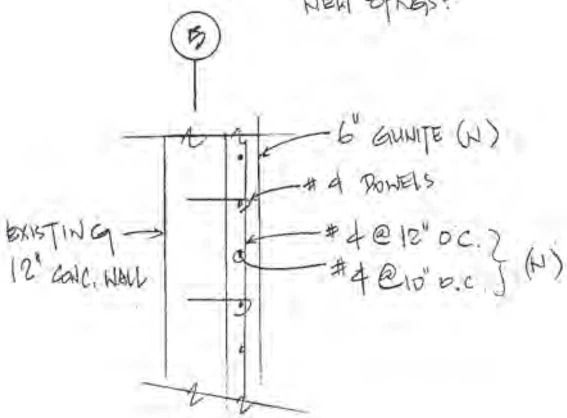
1006.00

CYGNA

Calculation Sheet

Project: CUPERTINO CITY HALL		Prepared By: LHB	Date: 3/86
Subject: LATERAL		Checked By: EAH	Date: MAY 86
System		Job No. S1502I	File No.
Analysis No.	Rev. No.	Sheet No. L117	





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