ENGINEERING REPORT

Seismic Evaluation

Everett YMCA

Everett, WA

APRIL 9, 2004

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TABLE OF CONTENTS

I. INTRODUCTION 1

A. SEISMIC EVALUATION OVERVIEW 1
B. BUILDING CODE REQUIREMENTS 1
C. PERFORMANCE BASED EVALUATION (ASCE 31-03) 2
D. SUMMARY OF EVALUATION 3

II. SCOPE OF WORK 4

III. BUILDING DESCRIPTION 5

A. GENERAL 5
B. DOCUMENT REVIEW 6
C. FOUNDATION SYSTEM 6
D. VERTICAL-LOAD-RESISTING SYSTEM 7
E. LATERAL-LOAD-RESISTING SYSTEM 8

IV. SEISMICITY 10

V. SEISMIC EVALUATION 12

A. GENERAL 12
B. ANALYSIS 12
C. RESULTS 13
D. RECOMMENDATIONS 14

VI. CONCLUSIONS 16

APPENDICES:

APPENDIX A – PHOTOGRAPHS
APPENDIX B – BUILDING PLANS
APPENDIX C – ASCE 31-03 CHECKLIST
APPENDIX D - CALCULATIONS

Everett YMCA
Seismic Evaluation Report

I. Introduction

The purpose of this study is to evaluate the expected performance of the Everett YMCA during an earthquake, and to provide general recommendations to strengthen the building, as required. The building structure was evaluated for general conformance to the requirements of ASCE 31-03, an approved national standard whose primary seismic performance objective is Life-Safety. It is assumed that structures that satisfy the Life-Safety criteria of ASCE 31-03 may be significantly damaged in a major earthquake, but the occupants should be able to safely exit the building, as discussed in Section B below.

The evaluation is based on a review of the available construction documents and cursory visual observations.

A. Seismic Evaluation Overview

Evaluating existing buildings for potential damage from an earthquake requires balancing structural engineering concerns with the current public policy of upgrading these buildings to reduce seismic risk. In general, public codes exist as a benchmark for a seismic evaluation. Consequently, priorities must be developed regarding loss of life and/or building damage in the event of an earthquake. Priorities are established based on two factors:

1. The level of risk to life and property.
2. The level of risk to structural elements of the building.

The level of risk reduction determines the objectives of the seismic evaluation. There are a number of seismic evaluation philosophies representing various performance goals. The evaluation of the Everett YMCA was performed using a life-safety objective.

B. Building Code Requirements

Many local building codes require that a seismic upgrade be performed if substantial alteration or renovation occurs with the building. Generally speaking, a renovation can be considered to be a substantial alteration if any of the following occurs:

1. Extensive structural repair.
2. Remodeling which substantially extends the useful physical and/or economic life of the building.
3. A change of a significant portion of a building to an occupancy that is more hazardous.
4. Reoccupancy of a building that has been vacant for over 12 months.
5. A significant increase in the occupant load of a URM building.

Substantial alteration requirements may also trigger additional fire safety, mechanical upgrade, or other renovations to be performed concurrent to seismic upgrades.

If a renovation is deemed a substantial alteration, the seismic provisions of the current building code, or an approved standard, are enforced. Currently, many local jurisdictions accept ASCE 31-03, the *Seismic Evaluation of Existing Buildings* as an approved standard. The seismic performance objective of ASCE 31-03 is either Life-Safety or Immediate-Occupancy. Published in 2003, ASCE 31-03 represents the most current evaluation methodology for the investigation of existing buildings

C. Performance Based Evaluation (ASCE 31-03)

The basis of this evaluation is the American Society of Civil Engineers document "Seismic Evaluation of Existing Buildings" (ASCE 31-03). ASCE 31-03 is the current standard for evaluation of existing structures. The purpose of the methodology is to provide guidance in the review of a building's response to earthquakes based on a "level of performance" philosophy. This document, published in July 2003, provides the most current consensus information.

ASCE 31-03 recommends the use of seismic forces that vary depending on the expected level of performance of the structure. The desired level of performance is chosen by the owner in conjunction with the design professional and local building authority. The level of performance may be either for Life-Safety or Immediate-Occupancy.

The Life-Safety performance level allows for significant damage to both structural and non-structural components during a design earthquake. Some margin of safety against either partial or total collapse remains. Injuries may occur, but the level of risk for life-threatening injury and entrapment is low. *In other words, substantial damage may be sustained by the building while still providing life-safety protection for the occupants and the ability to egress safely – reoccupancy is a secondary concern.*

The Immediate-Occupancy performance level allows very little damage to both structural and non-structural components during a design earthquake. The basic gravity and lateral-force-resisting systems remain essentially intact. The level of risk for life-threatening injury as a result of damage is very low. Although some minor repairs may be necessary, the building is expected to be habitable and operational after an event. Repairs may be completed while the building is occupied.

The analysis methodology of ASCE 31-03 employs a three tier methodology - the quick check methodology (Tier 1 analysis), a more rigorous and calculation intensive Tier 2 analysis, and a very detailed component evaluation (Tier 3 analysis) involving advanced computational methods including non-linear analysis.

The Tier 1 quick check employs a set of checklists for each building type. The checklist contains a set of evaluation statements (generally qualitative) which help identify areas of concern with regard to the structures' ability to adequately transmit earthquake forces to the foundation system and surrounding soils.

The Tier 2 analysis methodology involves numerical calculations to determine the stiffness and strength of various framing elements and connections within the structure, based on material and geometric properties. The values derived from the analysis are compared to code prescribed allowables in order to determine the "weak links" in the structural system.

The Tier 3 analysis methodology is a component-based evaluation procedure that relies on linear and non-linear, as well as static and dynamic analyses to verify acceptable performance. Tier 3 analyses are very computationally intensive and are generally impractical for typical buildings.

D. Summary of Evaluation

Evaluation force levels and their performance goals are based on the average performance of a particular building type. They do not relate in any rigorous fashion to a particular building. The general ASCE 31-03 methodology is appropriate to use as a basis for the analysis of these buildings, given their age, type of construction and occupancy. These buildings were evaluated for a Life-Safety performance goal.

II. Scope of Work

The scope of work for the seismic evaluation of the Everett YMCA includes the following:

1. Review of the available construction drawings for familiarization with the structural systems, including a cursory walkthrough of the building site to verify general conformance with the drawings.
2. Provide a Tier 1 evaluation of the buildings using ASCE 31-03.
3. Develop preliminary mitigation (strengthening) schemes to address concerns identified.
4. Provide a written report outlining and summarizing the findings and recommendations.

III. Building Description

A. General

The Everett YMCA is located at 2720 Rockefeller Avenue in Everett, Washington. The site consists of the original unreinforced masonry (URM) building built in 1920, a concrete masonry unit (CMU) building built in 1960, and another CMU building addition built in 1980.

1920 Building

The 1920 building has exterior dimensions of 115 feet in the north/south direction and 100 feet in the east/west direction and is five stories high. The stories vary in height, but are approximately 10 feet except for the 2nd story which is 14 feet. The exterior grade around the building perimeter varies between Level 1 and Level 2. The roof is sloped and measures approximately 55 feet above Level 1. The lowest story is constructed of concrete; the upper stories are constructed of URM exterior walls and wood framed floors and roof. A former swimming pool at Level 1 is now covered with a wood floor and used as an exercise room. At Level 3 there is a two-story gym on the North-West corner of the building that measures 42 feet by 82 feet and has a running track above. Directly east of the gym floor at Level 2 there is a courtyard that is 10 feet wide and 62 feet long. Levels 4 and 5 used to be dormitories and are currently unoccupied space.

1960 Building

The 1960 building was added to the North face of the 1920 building. The main building measures 48 feet in the north/south direction and 69 feet in the east/west direction and is four stories high. The stories also vary in height and are approximately 10 feet except for the 1st story which is 14 feet. The roof is flat and measures approximately 47 feet above Level 1. The floor levels do not match with those in the 1920 building except at Levels 1 and 3. The main entry to the 1960 Building was on the South-West corner of the building. The levels in the entry match the levels in the 1920 building and a stairway served as a link between the two buildings.

When the 1980 building was constructed, a big portion of this entry was demolished and the main entry was moved to the 1980 building. However, the small part that remains, measuring 16 feet by 24 feet including the stairway, still serves as the main link between the 1920 and 1960 buildings. The first story of the 1960 building is constructed of concrete; the upper stories are constructed of CMU walls and concrete floors with wood framing at the roof. There is a pool at the 1st level of the building, men's and women's lockers at the 2nd level, and a two story gym at level 3.

During construction of the 1960 building, the 1920 building was remodeled. The remodeling included the addition of three stairways to the West elevation of the 1920 building. Two of these stairways provide access to Level 1 from the exterior grade, and the third stairway provides access to Levels 1 through 3 in both the 1920 and 1960 buildings. The other major change is located at the interface between the two buildings where the previously sloped roof is now flat to match the flat roof in the new building. The drawings also indicate that the 1920 building was re-roofed.

1980 Building

The 1980 building is L-shaped in plan and located to the north of the 1960 building. It extends 77 feet to the north and 41 feet to the east. It is four stories high but towers over the other two buildings because its top story is 25 feet high. The roof is flat and measures 63 feet above Level 1. The floor elevations at Levels 1, 2 and 3 match those in the 1960 building. The walls in the first story are constructed of both concrete and CMU, while the walls in the stories above are all made of CMU. The floors consist of concrete on metal deck and the roof is both concrete on metal deck and untopped metal deck. There is a pool at the 1st level of the building, a two-story gym on the 2nd level, office space on the 3rd level and racquetball courts on the 4th level. There is a covered track on the roof level; two of the building stairways provide access to the track. The original construction documents for the 1980 building indicate that the building construction was to be in two phases. Based on existing conditions it is apparent that after phase I was completed phase II, which would have changed the interface between the three buildings, was never built.

B. Document Review

The following original construction documents were available for review:

- "Young Mens Christian Association, Everett, Wash", sheets 3, 5 and 7 dated June 7, 1920. The Architect of Record was Baker and Vogel. Drawings were in generally fair condition.
- "Alterations and Additions to Y.M.C.A. Everett, Wash", sheets 1 through 25, M1 through M10, and E1 through E6, dated February 12, 1960. The Architect of Record was Harold W. Hall and the Engineer of Record was Arthur A. Graves. Drawings were in generally fair condition.
- "Additions and Alterations to Everett Y.M.C.A", sheets 1 through 10, 14 through 38, SD-9, S1 through S14, S, M1 through M10, M12 through M23, E1 through E11, and a lot plan, dated May 9, 1980. The Architect of Record was Bryant and Frets and the Engineer of Record was Smith and Swenson, Inc. Drawings were in good condition.
- "YMCA. - Everett", mechanical sheets 1 through 11 dated February 9, 1981. The Architect of Record was Bryant and Frets. Drawings were in good condition.
- "Everett Family Y.M.C.A Locker Rooms Remodeling", sheets A1 through A5 dated August 3, 1988. The architect of record is The Dykeman Architects. Drawings were in good condition.

C. Foundation System

1920 Building

There are no drawings that show the foundation system of the 1920 building. It is assumed that there are spread footings below the interior concrete columns, a continuous strip footing below the exterior 19" thick concrete walls, and a concrete slab-on-grade at Level 1.

1960 Building

The foundation system consists of spread footings at the interior and exterior concrete columns, and a continuous strip footing at the exterior concrete walls. Level 1 is typically a 4 inch thick reinforced concrete slab-on-grade.

1980 Building

The foundation system consists of spread footings at the interior and exterior concrete and steel columns, and a continuous strip footing at the exterior and interior concrete/CMU walls. At the interface between the 1980 building and the North face of the 1960 building, 18 inch-diameter reinforced concrete piers were drilled diagonally from the 1980 building slab-on-grade to the underside of the 1960 building strip footing. Reinforced concrete was then placed to fill the gap between the bottom of the 1960 building footing and the top of the pier in an attempt to connect the foundations of the two buildings. Level 1 is typically a 4 inch thick reinforced concrete slab-on-grade.

D. Vertical-Load-Resisting System

1920 Building

At the sloped portion of the roof, the vertical-load-resisting system consists of 4" tongue-in-groove wood decking spanning 13 feet between the exterior URM walls and interior bearing stud walls. At the flat roof, the 4 inch thick tongue-in-groove wood decking spans between load bearing stud walls. The roof above the gym consists of 4 inch thick tongue-in-grove spanning approximately 13 feet between wood trusses. The wood trusses bear on an exterior URM wall and an interior wood stud wall.

At the 3rd through 5th floor levels, the vertical-load-resisting system consists of 4 inch thick tongue-in-groove decking spanning between wood beams. The beams are supported on the exterior URM walls and wood or steel posts.

At the 2nd floor level, the vertical-load-resisting system consists of a one-way concrete slab spanning between concrete beams. The concrete beams are supported on interior concrete columns and the exterior 19 inch thick concrete walls. A portion of the 2nd floor slab, measuring 30 feet by 37 feet and located in the middle of the east side of the building, is raised approximately 5 feet. The concrete slab at the raised portion is supported on concrete beams spanning between concrete columns and deep beams.

1960 Building

At the roof, the original construction drawings show the vertical-load-resisting system to consist of 4 inch thick tongue-in-groove wood decking spanning 14 feet between 11 inch wide by 22 inch deep glu-laminated beams. The glu-laminated beams are supported on wide flange columns and CMU columns. After a snow storm in 1996, a portion of the roof over the gym collapsed and was replaced with decking spanning between 4x wood joists supported on the existing glu-laminated beams. Drawings showing the new roof construction are not available.

At the 2nd through 4th floor levels, the vertical-load-resisting system consists of a one-way 5½ inch thick concrete reinforced slab spanning between concrete beams. The concrete beams are supported on concrete and CMU columns.

1980 Building

At the roof north of the 1960 building, the vertical-load-resisting system consists of 2½ inch concrete on 1½ inch deep metal deck spanning 5 feet 4 inches between open web steel joists. The joists are supported on the exterior CMU walls and steel wide flange beams. At the roof east of the 1960 building, the vertical-load-resisting system consists of 3 inch deep untopped metal deck spanning between steel wide flange beams. The steel beams are supported on steel wide flange girders that bear on the exterior CMU walls and on steel tube posts.

The covered track is located over the portion of the roof that is north of the 1960 building. The track vertical-load-resisting system consists of 3 inch deep untopped metal deck that spans 9 feet between steel tube beams supported on steel tube columns. The steel tube columns are supported on the exterior CMU walls and on the open web steel joists and steel wide flange beams at the building roof.

At the 2nd through 4th floor levels, the vertical-load-resisting system consists of 2½ inch concrete on 1½ inch deep metal deck spanning between open web steel joists and steel wide flange beams. The joists and the beams are supported by exterior and interior CMU or concrete walls and steel tube posts.

E. Lateral-Load-Resisting System

1920 Building

In general, exterior URM and concrete walls, the wood diaphragms at the roof and upper levels and the concrete diaphragm at the 2nd level act as the primary elements of the lateral-load-resisting system for the building. Earthquake induced inertia forces occur within the wood and concrete floor diaphragms, which then transfer the seismic forces to the exterior shear walls. The walls then transfer the seismic forces directly to the footings. In turn, the forces on the footings are resisted by friction and bearing pressure against the surrounding soils.

In addition to the exterior shear-resisting URM walls, there are 2x wood laminated walls in the building interior in both directions. However these walls can not be counted as part of the lateral-load-resisting system since they do continue to the foundation. These walls start at the 2nd and 3rd levels and go to the roof level. The walls are located below wood posts in the 2nd story and concrete columns in the 1st story.

1960 Building

In general, exterior concrete and CMU walls, the wood roof and concrete floors act as the primary elements of the lateral-load-resisting system for the building. In the east/west direction the exterior wall of the 1920 building is used to resist lateral forces in the 1960 building since there is only one exterior CMU wall on the North face. Earthquake induced inertia forces are resisted by the roof and floor diaphragms, which then transfer the seismic forces to the concrete and CMU walls. The concrete and CMU walls act as shear walls and transfer the seismic forces directly to the footings. In turn, the forces on the footings are resisted by friction and bearing pressure against the surrounding soils.

1980 Building

In general, concrete and CMU walls, the concrete roof and concrete floors act as the primary elements of the lateral-load-resisting system for the building. The exterior

CMU wall at the North face of the 1960 building is used to help resist lateral forces in the 1980 building. A braced frame located at the South face of the 1980 building directly east of the 1960 building is also part of the lateral-load-resisting system. Earthquake induced inertia forces are resisted by the roof and floor diaphragms, which then transfer the seismic forces to the concrete and CMU walls. The concrete and CMU walls act as shear walls and transfer the seismic forces directly to the footings. In turn, the forces on the footings are resisted by friction and bearing pressure against the surrounding soils. It should be noted that the exterior CMU walls are "stack bond" construction which provides less resistance to lateral forces than the interior CMU walls which are common bond construction.

The building plans in Appendix B show the location of the major shear walls at each level.

IV. Seismicity

The size of seismic events can be compared by using either magnitude or intensity. The magnitude of an earthquake is a quantitative measure of the amount of energy released, and does not depend on the distance from the earthquake's epicenter. On the other hand, the intensity is a qualitative measure of the damage level at a specific location. The Modified Mercalli Index of Intensity (MMI) is a common checklist for seismic reconnaissance, with an intensity of I indicating a barely perceptible seismic event to an intensity of XII indicating total damage (see Figure 4). The intensity usually decreases as the distance from the earthquake's epicenter increases. For example, an earthquake of magnitude 7.0 might generate damage of intensity VIII at the epicenter, but damage of intensity V a hundred miles from the epicenter. Therefore, magnitude may be used to compare the overall strengths of earthquakes, while intensities are used to compare the damage level at specific locations.

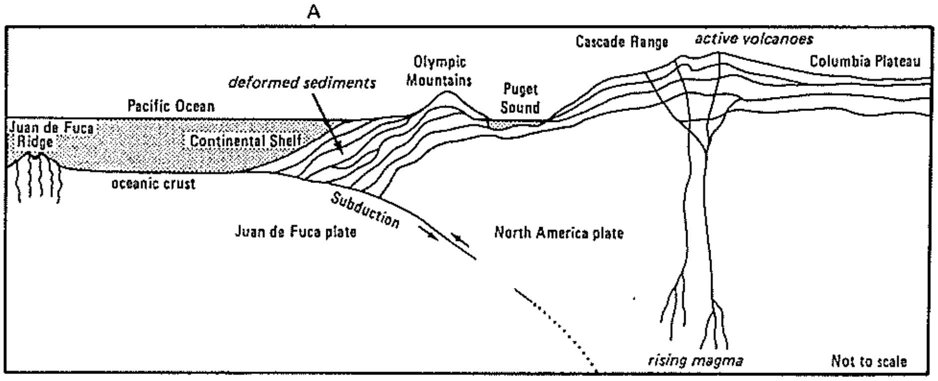
Everett, Washington, is located in the seismically active Puget Sound Basin. Historic earthquakes, capable of regional damage, have been reported in the area since the 1800's. Studies of earthquake activity, combined with evidence preserved in the regional geology, have defined three source zones responsible for Pacific Northwest earthquakes. These three zones are related to the slow movement of tectonic plates. The pushes and pulls of these moving plates are responsible for the forces that cause most of the earthquakes in the region. Ground shaking in Everett is likely to occur from one of these source zones:

Zone 1. Shallow earthquakes located in the North American Plate within 20 miles of the earth's surface.

Zone 2. Deep earthquakes located in the downward moving Juan de Fuca plate with ruptures more than 25 miles below the surface.

Zone 3. Shallow earthquakes occurring where the North American Plate and the Juan de Fuca Plate overlap.

A



Reference: Washington State Earthquake Hazards, Noson, Qamar, Thorsen, 1988.

Zone 1 earthquakes historically have been less than magnitude 6 in the Puget Sound Basin and up to magnitude 7.4 in the North Cascade Mountains. The recently identified shallow Seattle Fault has been identified to run along the I-90 corridor from

Bainbridge Island through Seattle through Bellevue and on to Issaquah. Though the geological structures responsible are poorly understood, current thinking among the scientific community estimates a potential magnitude 7+/- earthquake with recurrence intervals on the order of 1000 years along this fault. In addition, scientists have recently discovered several active surface faults ranging from northern Whidbey Island down to Tacoma. If this fault behaves similarly to shallow earthquakes in California, the expected ground shaking could be quite high, thus producing large intensities nearby. However, due to the long recurrence intervals, there is much uncertainty as to the degree that these high intensities should be considered.

Zone 2 earthquakes, generated by the tensional forces caused as the Juan de Fuca Plate descends beneath the overlying North American Plate, have historically caused the most damage in the state. Since the mid-1800's, at least five deep, Zone 2 earthquakes have caused damage of intensity VI or more in the Puget Sound area. In 1949, a magnitude 7.1 earthquake generated intensity VIII damage. This is the same region in which the February 28, 2001 Nisqually (magnitude 6.8) earthquake was located. Historically, Zone 2 earthquakes have been concentrated to the north (in the Georgia Strait) and in the southern Puget Sound Basin between Seattle and Olympia. Magnitude 7, Zone 2 earthquakes occur about every 150-to-200 years in the Puget Sound area. A magnitude 7.5, Zone 2 earthquake directly beneath the site could generate MMI's of VIII to IX.

Zone 3 earthquakes are produced when the North American Plate and the Juan de Fuca Plate suddenly jerk by each other. No earthquakes of this type have been recorded by instruments in this area. Geologic evidence suggests the last Zone 3 earthquake occurred approximately 300 years ago, however, there is no specific record of the event. Zone 3 events are expected to be magnitude 8+ and occur about every 500 years. Ground shaking in the Puget Sound Basin from this type of earthquake would be equal to or less than a deep Zone 2 event because of the greater epicentral distance (100+ miles). The extent of damage to buildings from a Zone 3 event is more difficult to estimate because the duration of ground shaking is expected to be considerably longer than the more frequently occurring types of earthquakes.

V. Seismic Evaluation

The supporting documentation for the evaluation is located in the Appendices. Appendix A contains photographs of the building. Appendix B contains the building plans. Appendix C contains the ASCE 31-03 checklists, which are a collection of evaluation statements to highlight potential deficiencies that require further investigation. Appendix D contains supporting calculations.

A. General

During an earthquake, the horizontal acceleration of the ground induces inertia forces in the buildings. These inertia forces are proportional to the building weights; they are primarily horizontal (lateral) and must be resisted by the buildings' lateral-force-resisting system. If the structures cannot resist the lateral forces induced by the seismic ground motion, they would suffer damage to both structural and non-structural elements and potentially collapse.

All buildings have some minor level of inherent lateral force resistance, simply due to the nature of how various building materials are connected and constructed. The seismic evaluation of a building simply determines the level to which the individual elements can resist the recommended earthquake forces.

As noted previously, the lateral-force-resisting system in the original 1920 building consists of flexible wood diaphragms at the upper levels, a rigid concrete diaphragm at the 2nd level, exterior URM walls, and exterior concrete shear walls. The lateral-force-resisting system in the 1960 building consists of a flexible wood diaphragm at the roof level, rigid concrete floor diaphragms, and CMU and reinforced concrete shear walls. The 1960 building also utilizes the exterior URM wall at the north face of the 1920 building to resist lateral forces. The lateral-force-resisting system in the 1980 building consists of rigid roof and floor diaphragms, CMU and reinforced concrete. The 1980 building also utilizes the exterior CMU and concrete shear wall at the north face of the 1960 building to resist lateral forces.

Inertial forces generated in the buildings must be transferred to the foundations through a continuous load path. Forces in these systems are transferred to the walls via diaphragm (horizontal beam) action of the roof and floors. The wood diaphragms behave as flexible diaphragms, distributing the forces to the walls based on their tributary area. The concrete diaphragms behave as rigid elements, distributing forces to the frames and walls in proportion to their stiffness. The diaphragms and walls must have the strength necessary to resist the lateral forces and enough stiffness to prevent excessive lateral displacement of the roof and floors.

B. Analysis

The analysis methodology of ASCE 31-03 employs a three tier methodology, as described in Section I., Introduction. For the purpose of this report, the Tier 1 analysis (the quick check methodology) was performed on the 1920, 1960 and 1980 buildings.

As discussed in Section I., Introduction, the analysis for Tier 1 consists of checklists composed primarily of qualitative evaluation statements. For the 1920 building, the checklists for Building Type URM (Unreinforced Masonry Bearing Walls with Flexible Diaphragms) were used. For the 1960 building three checklists were used; RM1 (Reinforced Masonry Bearing Walls with Flexible Diaphragms); RM2 (Reinforced Masonry Bearing Walls with Rigid Diaphragms); and C2 (Concrete Shear Walls with Stiff Diaphragms). For the 1980 building, the checklists for RM2 (Reinforced Masonry Bearing Walls with Rigid Diaphragms) were used. Both the Basic and Supplemental checklists were required due to high seismicity. These checklists are presented in Appendix C.

Calculations corresponding to this analysis may be found in Appendix D.

C. Results

Per the ASCE 31-03 analysis methodology, the 1920, 1960 and 1980 buildings were found to contain most of the key elements required to form a complete load path for resisting earthquake forces. However, several deficiencies were identified in the existing lateral-load-resisting systems for all three buildings. The following sections contain the results of the Tier 1 analyses.

Appendix C contains the checklists for the Tier 1 analysis for the buildings. The areas that were identified as needing further investigation are as follows:

1920 Building

1. It is assumed that there are no continuous cross ties between diaphragm chords.
2. The span ratio for the tongue-in-groove floor diaphragms exceeds the recommended limit for unblocked diaphragms.
3. The diaphragms are not adequately connected to the URM exterior walls for transfer of in-plane and out-of-plane lateral loads.
4. The exterior URM walls are not anchored for out-of-plane forces at the diaphragm levels as noted in 3. This is apparent at the gym roof, where there are diagonal cracks in the exterior URM walls at each of the wood trusses as a result of the last major earthquake.
5. The shear stress in the URM exterior walls exceeds the maximum quick-check values.
6. There are diagonal cracks in the masonry walls that are greater than 1/8 inch.
7. The chimneys at the three building corners exceed height-to-width ratios and pose a potential falling hazard.

1960 Building

1. There are no cross ties between roof diaphragm chords in the east/west direction.
2. The span ratio for the tongue-in-groove roof diaphragm exceeds the recommended limit for an unblocked diaphragm.

3. There is a vertical discontinuity at the North face exterior CMU wall due to an opening along most of the wall length. This opening occurs below the roof and 3rd floor levels.
4. The shear stresses in the CMU exterior wall on the east side exceed the maximum quick-check values.
5. The horizontal reinforcing in the CMU walls is inadequate.

1980 Building

1. The CMU shear wall at the south side is not continuous to the foundation
2. The shear stresses in the CMU exterior walls do not exceed the maximum recommended quick-check value of 70 psi. However the exterior walls are of "stack bond" construction, which has significantly less shear capacity than 70 psi.

D. Recommendations

The following recommendations were developed to address the problems described previously in the Results.

1920 Building

1. Provide continuous cross ties between diaphragm chords using metal ties and straps.
2. Add interior shear walls or braced frames to reduce span ratios. Add ½" plywood sheathing at all levels 3, 4, roof, in order to increase diaphragm capacities.
3. Strengthen connections between the diaphragm and the walls by adding steel angles or bent plates with expansion bolts.
4. Repair, repoint the damaged URM walls.
5. Provide new shear walls and/or braced frames to reduce the stresses in the URM walls. Add shotcrete to the wall on the north face of the building as it resists load from the 1960 building in addition to load from the 1920 building.
6. Repair, repoint the exterior URM walls.
7. Provide bracing for the chimneys, or demolish down to the roof level.

1960 Building

1. Provide continuous cross ties between roof diaphragm chords using metal ties and straps.
2. Add ½" plywood sheathing at roof level in order to increase diaphragm capacity.
3. Infill existing wall opening at north face with concrete.
4. Add shotcrete to wall on east side of building.
5. Adding shotcrete to wall on east side of the building also addresses item 5 as the shotcrete increases the wall capacity.

1980 Building

1. Provide a steel angle connection below the discontinuous wall to transfer the load to the adjacent 1960 concrete shear wall.
2. Further evaluation is needed to determine whether the exterior "stack bond" CMU walls are adequate. This would involve the use of a pachometer to locate the horizontal wall rebar. The results of further evaluation would probably indicate that some of the exterior walls would need to be strengthened by adding shotcrete.

Appendix B contains building plans that show a preliminary strengthening scheme based on these recommendations.

VI. Conclusions

Based on the ASCE 31-03 methodology, the Everett YMCA does not currently meet the requirements for a complete lateral-force-resisting-system. Recommendations have been provided to mitigate the noted deficiencies. These recommendations for the 1920 building include strengthening the plywood roof and floor diaphragms, providing new interior concrete walls and braced frames to reduce the forces in the existing URM walls; and providing new floor attachments to tie the wood diaphragms to the exterior walls. For the 1960 building, the recommendations include strengthening the plywood roof diaphragm, infilling the wall openings at the North face wall with reinforced concrete, and adding shotcrete to the exterior CMU wall on the east side . For the 1980 building, the recommendations include providing drag struts to the deliver load to the shear walls and adding shotcrete to the exterior CMU walls.

The completion of the seismic retrofitting as outlined in the Recommendations section is expected to bring the buildings' performance to a Life-safety level as outlined in ASCE 31-03.

Appendix A
Photographs

East Elevation of the 1920 Building

Partial South Elevation of the 1920 Building

West Elevation of 1920 Building

West Elevation of 1960 Building

Partial West Elevation of the 1960 and 1980 Buildings

North Elevation of the 1980 Building

East Elevation of the 1980 Building

South Elevation of 1960 Building Looking from Level 3 Courtyard at 1920 Building

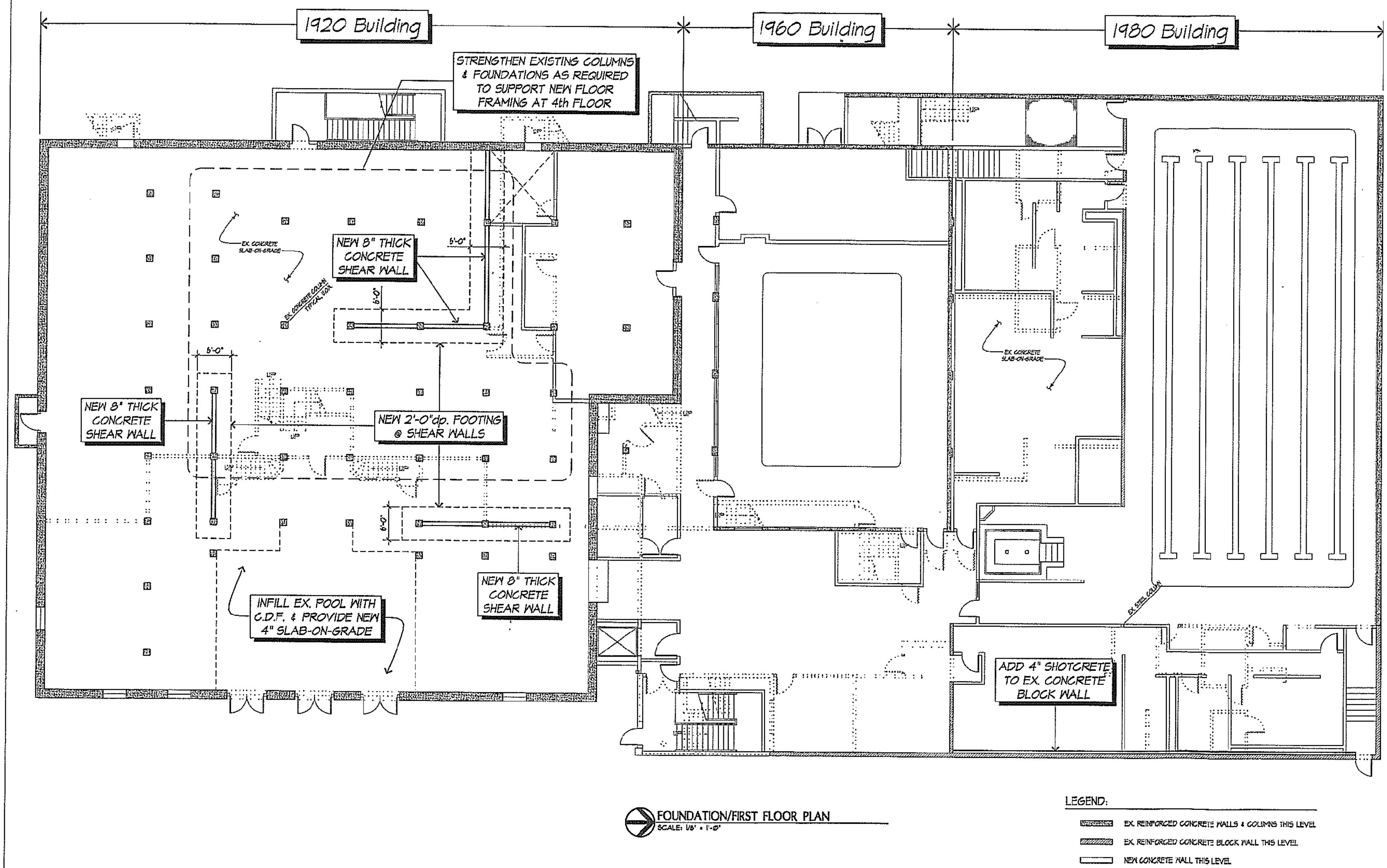
Raised Portion of Level 2 in the 1920 Building

Gym Roof in the 1920 Building

Roof of 1920 Building Looking from Gym Roof of 1960 Building

Track on Roof of 1980 Building

Appendix B
Building Plans



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Revisions

YMCA
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Drawing Title

FOUNDATION/FIRST FLOOR PLAN

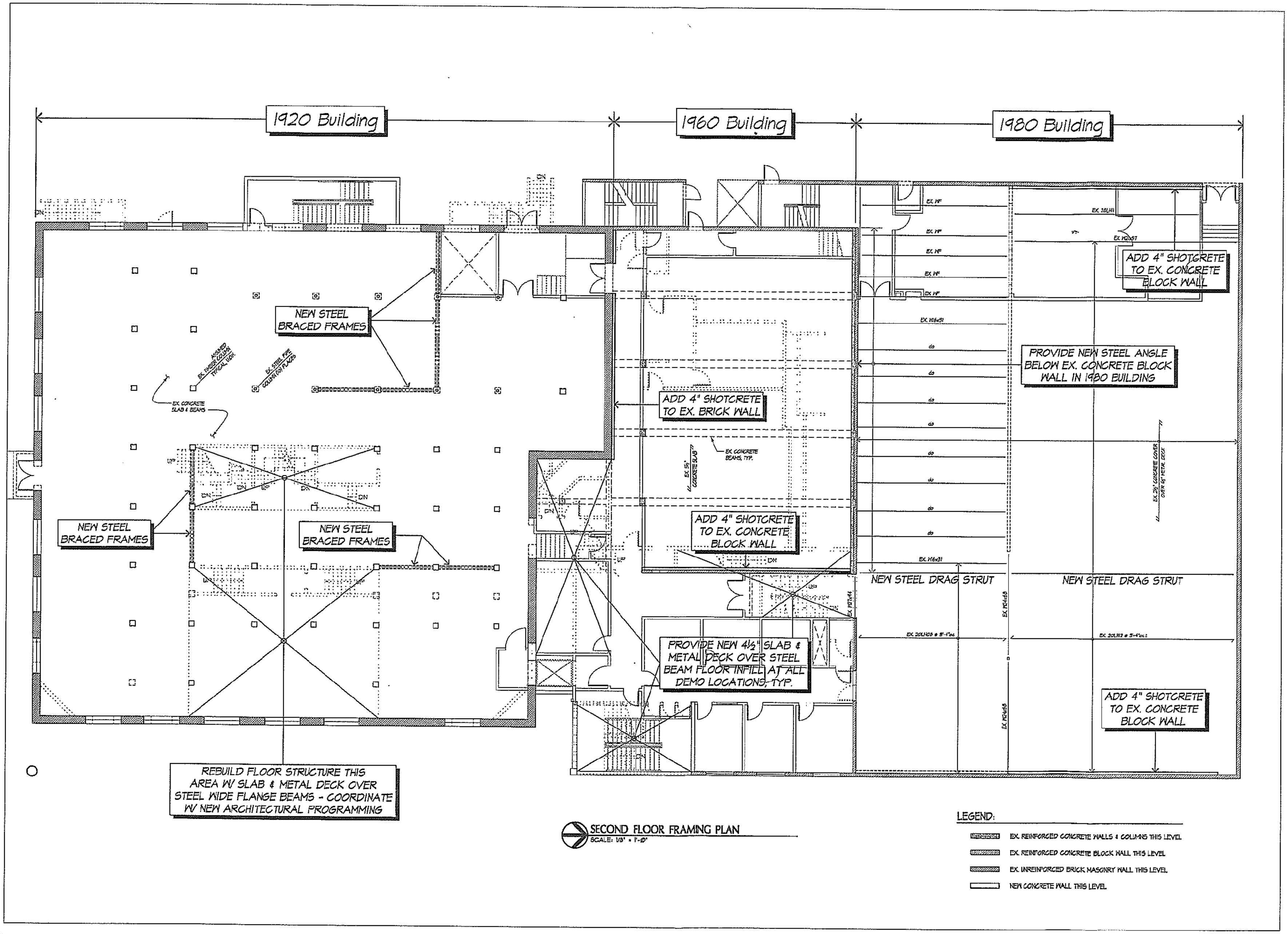
COUGHLINPORTERLUNDEEN

TERRY R. LUNDEEN

Date: APRIL 5, 2004
Job No: S040194-01
Drawn By: HRB
Checked By: SJS, RMF

Drawing No.

S2.1



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Revisions

YMCA
Everett Family Branch

YMCA of Snohomish County
2720 Rockefeller Ave.
Everett, Washington 98201

Drawing Title

SECOND FLOOR
FRAMING PLAN

COUGHLINPORTERLUNDEEN

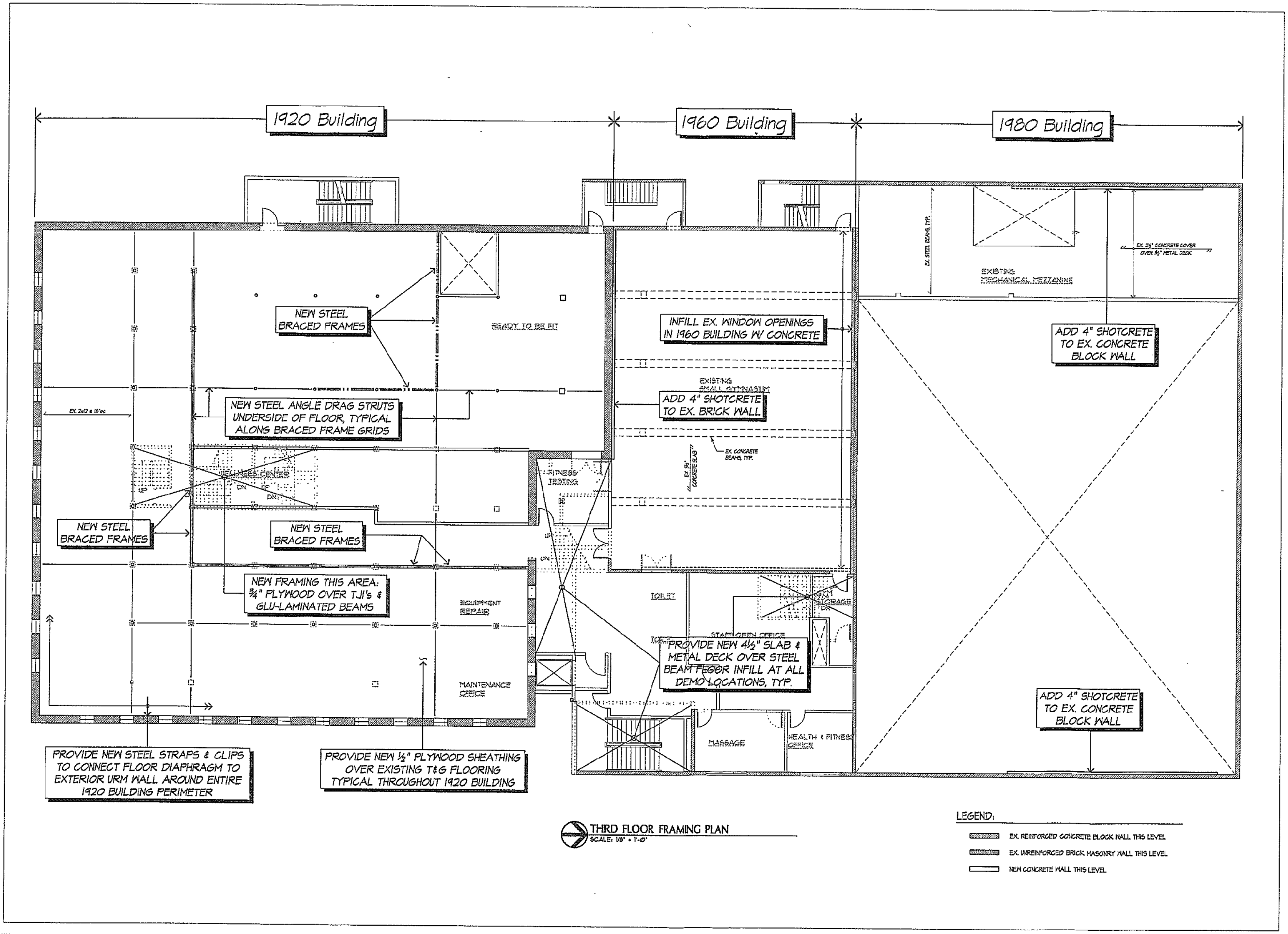
TERRY R. LUNDEEN
STATE OF WASHINGTON
PROFESSIONAL ENGINEER

EXPIRES 1/21/05

Date:	APRIL 9, 2004
Job No:	3040794-01
Drawn By:	HRB
Checked By:	SJS, RMF

Drawing No.

S2.2



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Revisions

YMCA
Everett Family Branch

YMCA of Snohomish County
2720 Rockefeller Ave.
Everett, Washington 98201

Drawing Title

THIRD FLOOR FRAMING PLAN

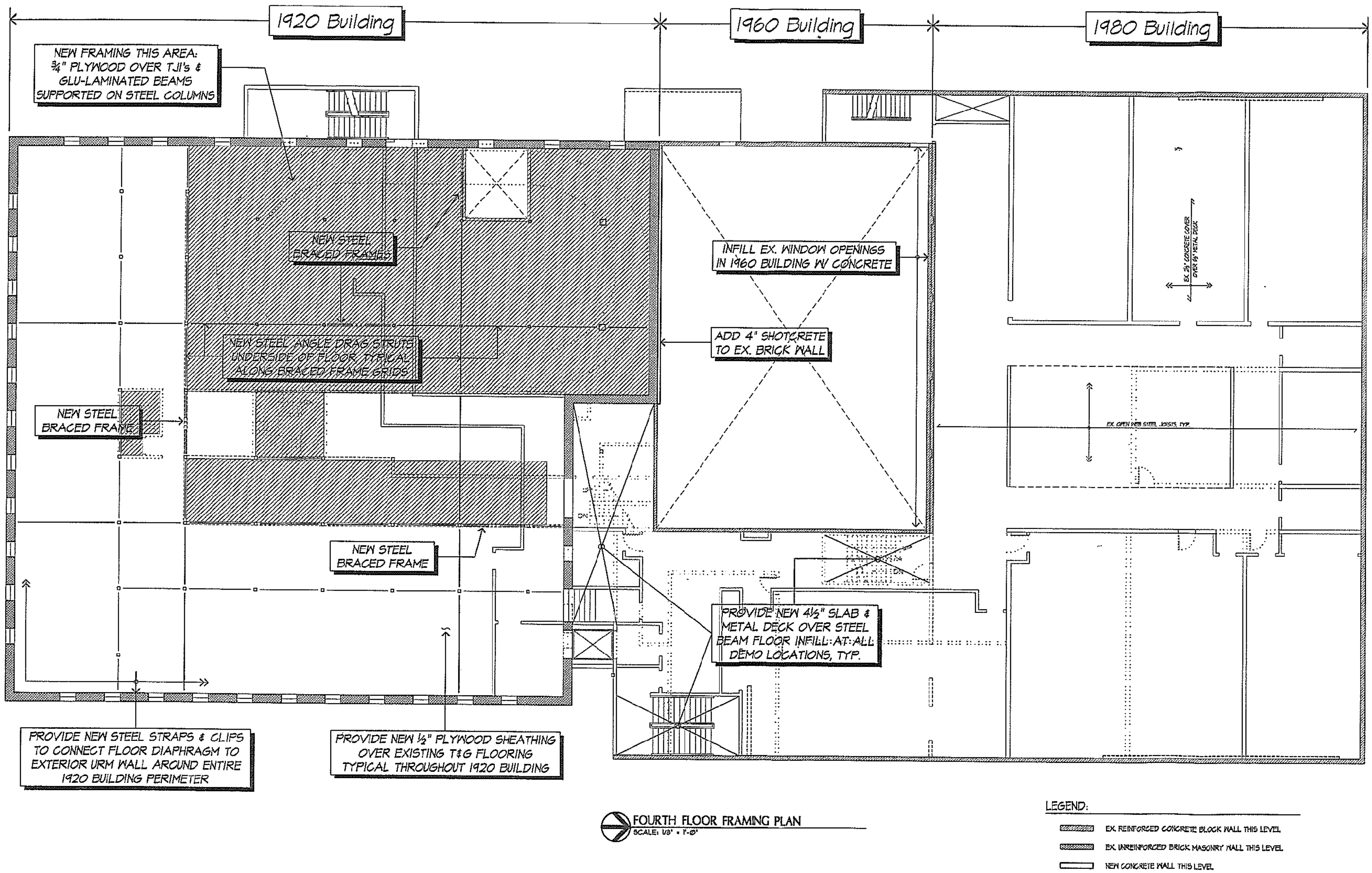
COUGHLINPORTERLUNDEEN

TERRY R. LUNDEEN

Date: APRIL 9, 2004
Job No: 2040194-01
Drawn By: HRB
Checked By: SIS, RMF

Drawing No.

S2.3



FOURTH FLOOR FRAMING PLAN
SCALE: 1/8" = 1'-0"

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Revisions

YMCA
Everett Family Branch

YMCA of Snohomish County
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Everett, Washington 98201

Drawing Title

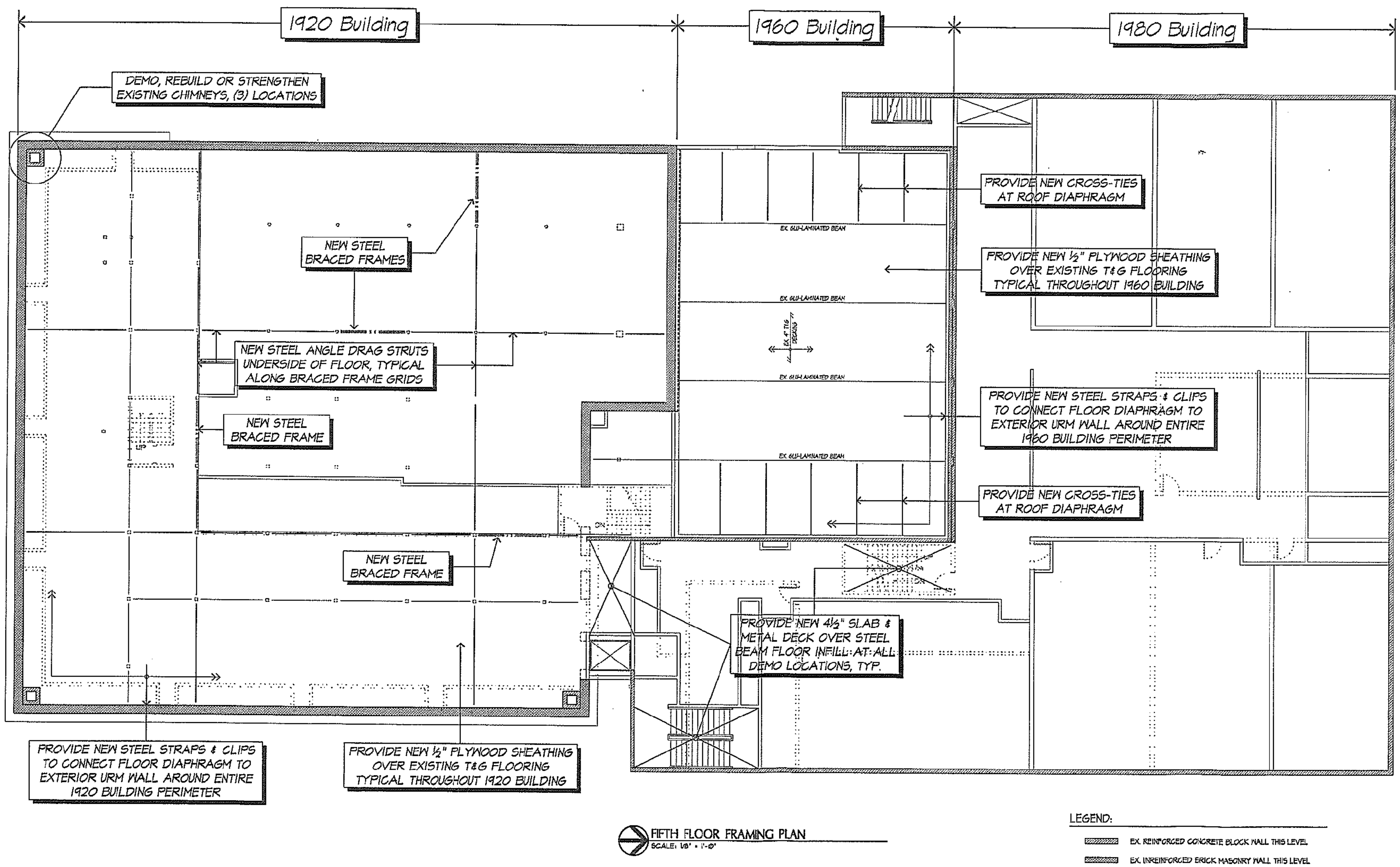
FOURTH FLOOR
FRAMING PLAN

COUGHLINPORTERLUNDEEN
A CONSULTING STRUCTURAL AND CIVIL ENGINEERING CORPORATION
TERRY R. LUNDEEN
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

Date: APRIL 9, 2004
Job No: S040194-01
Drawn By: HRB
Checked By: SIS, RMF

Drawing No.

S2.4



FIFTH FLOOR FRAMING PLAN
SCALE: 1/8" = 1'-0"

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Revisions

YMCA
Everett Family Branch

YMCA of Snohomish County
2720 Rockefeller Ave.
Everett, Washington 98201

Drawing Title

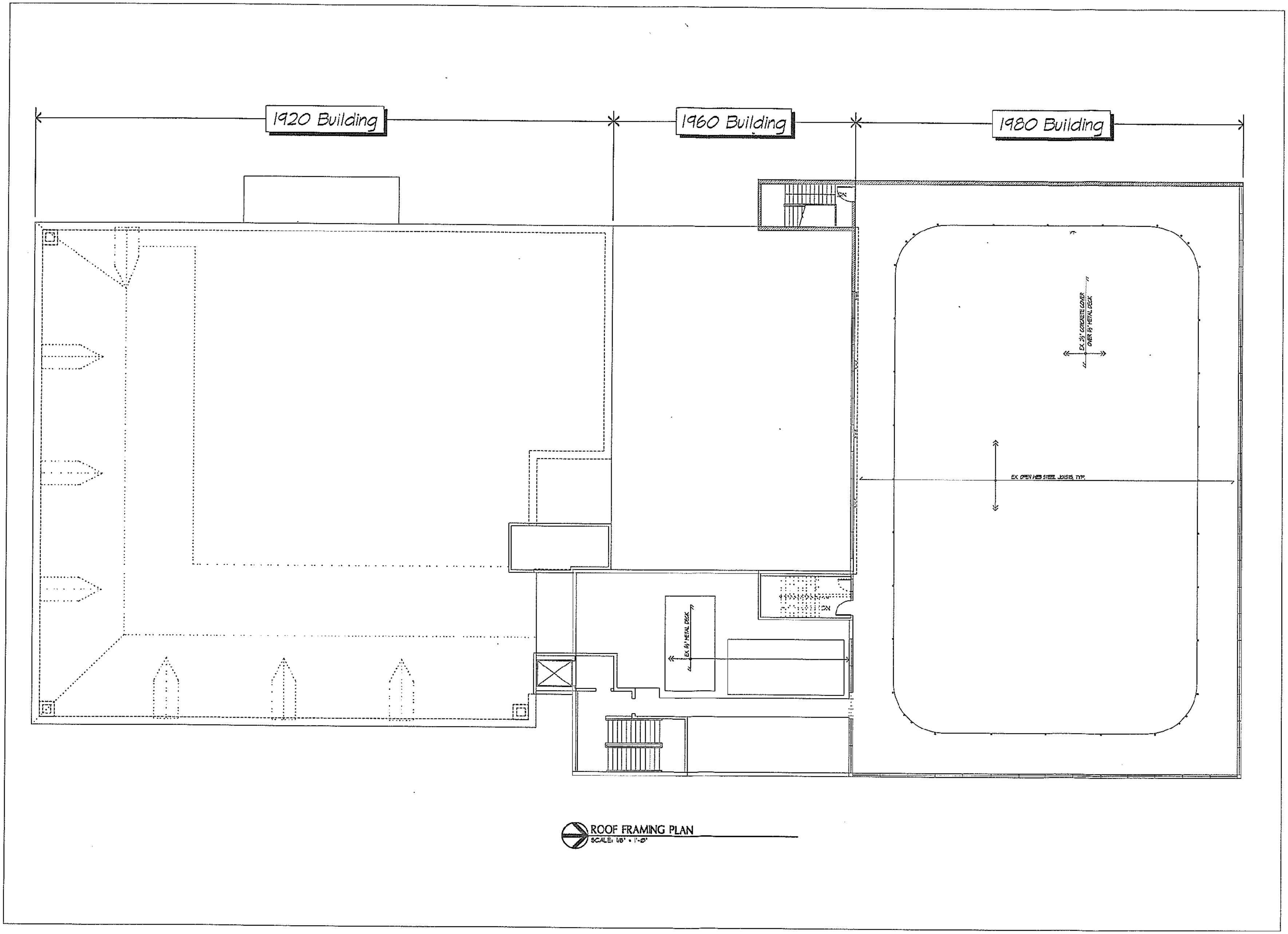
FIFTH FLOOR
FRAMING PLAN

COUGHLINPORTERLUNDEEN
TERRY R. LUNDEEN

Date: APRIL 9, 2004
Job No: S040754-01
Drawn By: HRB
Checked By: SJS, RMF

Drawing No.

S2.5



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Revisions

YMCA
Everett Family Branch

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Everett, Washington 98201

Drawing Title

ROOF FRAMING PLAN

COUGHLINPORTERLUNDEEN

TERRY R. LUNDEEN
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

EXPIRES 1/22/05

Date:	APRIL 9, 2004
Job No:	S040154-01
Drawn By:	HRB
Checked By:	SJS, RMF

Drawing No.

S2.6

Appendix C
ASCE 31-03 Checklist

Everett YMCA 1960's
At basement

3.7.9 Basic Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C3.7.9 Basic Structural Checklist for Building Type C2

These buildings have floor and roof framing that consists of cast-in-place concrete slabs, concrete beams, one-way joists, two-way waffle joists, or flat slabs. Floors are supported on concrete columns or bearing walls. Lateral forces are resisted by cast-in-place concrete shear walls. In older construction, shear walls are lightly reinforced but often extend throughout the building. In more recent construction, shear walls occur in isolated locations and are more heavily reinforced with boundary elements and closely spaced ties to provide ductile performance. The diaphragms consist of concrete slabs and are stiff relative to the walls. Foundations consist of concrete spread footings, mat foundations, or deep foundations.

Building System

C NC N/A — LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)

C NC N/A — MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)

C NC N/A — WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)

C NC N/A — SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)

C NC N/A — GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3)

C NC N/A — VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)

C NC N/A — MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)

C NC N/A — ~~TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20 percent of the building width in either plan dimension for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.6)~~

C NC N/A — DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements. (Tier 2: Sec. 4.3.3.4)

C NC N/A — POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used. (Tier 2: Sec. 4.3.3.5)

C NC N/A — CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.9)

Lateral-Force-Resisting System

C NC N/A — COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical-load-carrying system. (Tier 2: Sec. 4.4.1.6.1)

C NC N/A — REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)

C NC N/A — SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than the greater of 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.1)

C NC N/A — REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18 inches for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.2)

$\rho_h < 0.0025$

ok since stresses low

Connections

C NC N/A — ~~TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.1)~~

C NC N/A — ~~FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety, and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. (Tier 2: Sec. 4.6.3.5)~~

3.7.9S Supplemental Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragms

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral-Force-Resisting System

C NC N/A DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of Sections 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy. (Tier 2: Sec. 4.4.1.6.2)

C NC N/A FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.1.6.3)

C NC N/A COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than *d*/2 and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.3) No coupling bms

C NC N/A OVERTURNING: All shear walls shall have aspect ratios less than 4-to-1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.4)

C NC N/A CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.5)

C NC N/A REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.6)

C NC N/A WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 inches. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.7)

Diaphragms

C NC N/A DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints. (Tier 2: Sec. 4.5.1.1)

C NC N/A OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25 percent of the wall length for Life Safety and 15 percent of the wall length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.4)

C NC N/A PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

C NC N/A DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)

Connections

C NC N/A UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. (Tier 2: Sec. 4.6.3.10)

C NC N/A MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)

C NC N/A DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members, and none of the metal connection hardware shall be deteriorated, broken, or loose. (Tier 2: Sec. 4.3.3.1)

C NC N/A MASONRY UNITS: There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)

C NC N/A MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)

C NC N/A REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.10)

Lateral-Force-Resisting System

C NC N/A REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)

in longit. direction, the North wall of 1920's bldg is used to resist shear

C NC N/A SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)

C NC N/A REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)

Horiz reinf inadequate

Connections

C NC N/A WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 3.5.3.7. (Tier 2: Sec. 4.6.1.1)

C NC N/A WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)

C NC N/A TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.1)

C NC N/A FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety, and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. (Tier 2: Sec. 4.6.3.5)

No fnd details, assume OK

C NC N/A GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)

3.7.13 Basic Structural Checklist for Building Type RM1: Reinforced Masonry Bearing Walls with Flexible Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C3.7.13 Basic Structural Checklist for Building Type RM1

These buildings have bearing walls that consist of reinforced brick or concrete block masonry. Wood floor and roof framing consists of wood joists, glulam beams, and wood posts or small steel columns. Steel floor and roof framing consists of steel beams or open web joists, steel girders, and steel columns. Lateral forces are resisted by the reinforced brick or concrete block masonry shear walls. Diaphragms consist of straight or diagonal wood sheathing, plywood, or untopped metal deck, and are flexible relative to the walls. Foundations consist of brick or concrete spread footings or deep foundations.

Building System

C NC N/A LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)

C NC N/A ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4 percent of the height of the shorter building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.1.2)
compliant since adjacent bldgs are connected for seismic loads.

C NC N/A MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)

C NC N/A WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)

C NC N/A SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)

C NC N/A GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3)

C NC N/A VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)
openings in north face walls

3.7.13S Supplemental Structural Checklist for Building Type RM1: Reinforced Masonry Bearing Walls with Flexible Diaphragms

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral-Force-Resisting System

C NC N/A REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)

C NC N/A PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)

Diaphragms

C NC N/A CROSS TIES: There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)

C NC N/A OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25 percent of the wall length for Life Safety and 15 percent of the wall length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.4)

C NC N/A OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)

C NC N/A PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

C NC N/A DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)

C NC N/A STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2-to-1 for Life Safety and 1-to-1 for Immediate Occupancy in the direction being considered. (Tier 2: Sec. 4.5.2.1) 69'/48' = 1.43 < 2

C NC N/A SPANS: All wood diaphragms with spans greater than 24 feet for Life Safety and 12 feet for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing. (Tier 2: Sec. 4.5.2.2)

C NC N/A UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms shall have horizontal spans less than 40 feet for Life Safety and 30 feet for Immediate Occupancy and shall have aspect ratios less than or equal to 4-to-1 for Life Safety and 3-to-1 for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)

C NC N/A NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 feet and shall have span/depth ratios less than 4-to-1. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)

C NC N/A OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec. 4.5.7.1)

Connections

C NC N/A STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)

Everett YMCA 1960's Bldg.
AT FLOORS

3.7.14 Basic Structural Checklist for Building Type RM2: Reinforced Masonry Bearing Walls with Stiff Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C3.7.14 Basic Structural Checklist for Building Type RM2

These buildings have bearing walls that consist of reinforced brick or concrete block masonry. Diaphragms consist of metal deck with concrete fill, precast concrete planks, tees, or double-tees, with or without a cast-in-place concrete topping slab, and are stiff relative to the walls. The floor and roof framing is supported on interior steel or concrete frames or interior reinforced masonry walls.

Building System

C NC N/A LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)

C NC N/A MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)

C NC N/A WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)

C NC N/A SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)

C NC N/A GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3)

C NC N/A VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)

C NC N/A MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)

C NC N/A TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20 percent of the building width in either plan dimension for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.6)

C NC N/A DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements. (Tier 2: Sec. 4.3.3.4)

C NC N/A MASONRY UNITS: There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)

C NC N/A MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)

C NC N/A REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.10)

Lateral-Force-Resisting System

C NC N/A REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)

C NC N/A SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)

C NC N/A REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)

Diaphragms

C NC N/A TOPPING SLAB: Precast concrete diaphragm elements shall be interconnected by a continuous reinforced concrete topping slab. (Tier 2: Sec. 4.5.5.1)

Connections

C NC N/A WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 3.5.3.7. (Tier 2: Sec. 4.6.1.1)

C NC N/A TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.1)

C NC N/A TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements shall be doweled for transfer of forces into the shear wall or frame elements for Life Safety, and the dowels shall be able to develop the lesser of the shear strength of the walls, frames, or slabs for Immediate Occupancy. (Tier 2: Sec. 4.6.2.3)

C NC N/A FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety, and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. (Tier 2: Sec. 4.6.3.5)

C NC N/A GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)

3.7.14S Supplemental Structural Checklist for Building Type RM2: Reinforced Masonry Bearing Walls with Stiff Diaphragms

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral-Force-Resisting System

C NC N/A REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.6)

C NC N/A PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)

Diaphragms

C NC N/A OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25 percent of the wall length for Life Safety and 15 percent of the wall length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.4)

C NC N/A OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)

C NC N/A PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

C NC N/A DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)

Everett YMCA 1980's Bldg

3.7.14 Basic Structural Checklist for Building Type RM2: Reinforced Masonry Bearing Walls with Stiff Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C3.7.14 Basic Structural Checklist for Building Type RM2

These buildings have bearing walls that consist of reinforced brick or concrete block masonry. Diaphragms consist of metal deck with concrete fill, precast concrete planks, tees, or double-tees, with or without a cast-in-place concrete topping slab, and are stiff relative to the walls. The floor and roof framing is supported on interior steel or concrete frames or interior reinforced masonry walls.

Building System

C NC N/A LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)

C NC N/A MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)

C NC N/A WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)

C NC N/A SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)

C NC N/A GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3)

C NC N/A VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)

Wall btwn 60's & 80's bldg discontinuous

C NC N/A MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)

C NC N/A TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20 percent of the building width in either plan dimension for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.6)

C NC N/A DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements. (Tier 2: Sec. 4.3.3.4)

C NC N/A MASONRY UNITS: There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)

C NC N/A MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)

C NC N/A REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.10)

Lateral-Force-Resisting System

C NC N/A REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)

C NC N/A SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)
However, assuming a lower capacity for stacked bond, walls could be NC.

C NC N/A REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)

Diaphragms

C NC N/A TOPPING SLAB: Precast concrete diaphragm elements shall be interconnected by a continuous reinforced concrete topping slab. (Tier 2: Sec. 4.5.5.1)

Connections

C NC N/A WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 3.5.3.7. (Tier 2: Sec. 4.6.1.1)

C NC N/A TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.1)

C NC N/A TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements shall be doweled for transfer of forces into the shear wall or frame elements for Life Safety, and the dowels shall be able to develop the lesser of the shear strength of the walls, frames, or slabs for Immediate Occupancy. (Tier 2: Sec. 4.6.2.3)

C NC N/A FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety, and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. (Tier 2: Sec. 4.6.3.5)

C NC N/A GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)

3.7.14S Supplemental Structural Checklist for Building Type RM2: Reinforced Masonry Bearing Walls with Stiff Diaphragms

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral-Force-Resisting System

C NC N/A REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.6)

C NC N/A PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)

Diaphragms

C NC N/A OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25 percent of the wall length for Life Safety and 15 percent of the wall length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.4)

C NC N/A OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)

C NC N/A PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

C NC N/A DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)

EVERETT YMCA 1920's Bldg

3.7.15 Basic Structural Checklist for Building Type URM: Unreinforced Masonry Bearing Walls with Flexible Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the Tier 2 Special Procedure for Unreinforced Masonry or the Tier 3 Evaluation Procedure.

C3.7.15 Basic Structural Checklist for Building Type URM

These buildings have bearing walls that consist of unreinforced (or lightly reinforced) brick, stone, or concrete block masonry. Wood floor and roof framing consists of wood joists, glulam beams, and wood posts or small steel columns. Steel floor and roof framing consists of steel beams or open web joists, steel girders, and steel columns. Lateral forces are resisted by the brick or concrete block masonry shear walls. Diaphragms consist of straight or diagonal lumber sheathing, structural wood panels, or untopped metal deck, and are flexible relative to the walls. Foundations consist of brick or concrete spread footings or deep foundations.

Building System

C NC N/A LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)

C NC N/A ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4 percent of the height of the shorter building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.1.2)

1960's Bldg ht ≅ 32' above grade ; 4% of 32' = 15"
Since bldgs are attached for seismic loads, OK

C NC N/A MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)

C NC N/A WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)

C NC N/A SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)

C NC N/A GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3)

C NC N/A VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)

C NC N/A MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)

C NC N/A DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members, and none of the metal connection hardware shall be deteriorated, broken, or loose. (Tier 2: Sec. 4.3.3.1)

C NC N/A MASONRY UNITS: There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)

C NC N/A MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)

C NC N/A UNREINFORCED MASONRY WALL CRACKS: There shall be no existing diagonal cracks in the wall elements greater than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, or out-of-plane offsets in the bed joint greater than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.11)

Lateral-Force-Resisting System

C NC N/A REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)

C NC N/A SHEAR STRESS CHECK: The shear stress in the unreinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 30 psi for clay units and 70 psi for concrete units for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.5.1)

The stress in the North Face Wall that resists load from both the 1960 Building and the 1920 Bldg is 99 psi

Connections

C NC N/A WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 3.5.3.7. (Tier 2: Sec. 4.6.1.1)

C NC N/A WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)

C NC N/A TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2 Sec. 4.6.2.1)

No details, assume non-compliant

C NC N/A GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)

3.7.15S Supplemental Structural Checklist for Building Type URM: Unreinforced Masonry Bearing Walls with Flexible Diaphragms

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral-Force-Resisting System

C NC N/A PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than the following for Life Safety and Immediate Occupancy (Tier 2: Sec. 4.4.2.5.2):

Top story of multi-story building	9
First story of multi-story building	15
All other conditions	13

C NC N/A MASONRY LAY-UP: Filled collar joints of multi-wythe masonry walls shall have negligible voids. (Tier 2: Sec. 4.4.2.5.3)

Diaphragms

C NC N/A CROSS TIES: There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2) No details, assumed NC.

C NC N/A OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25 percent of the wall length for Life Safety and 15 percent of the wall length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.4)

C NC N/A OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)

C NC N/A PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

C NC N/A DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)

C NC N/A STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2-to-1 for Life Safety and 1-to-1 for Immediate Occupancy in the direction being considered. (Tier 2: Sec. 4.5.2.1) At gym: span/depth = 82'/45' = 1.82

C NC N/A SPANS: All wood diaphragms with spans greater than 24 feet for Life Safety and 12 feet for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing (Tier 2: Sec. 4.5.2.2)

C NC N/A UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms shall have horizontal spans less than 40 feet for Life Safety and 30 feet for Immediate Occupancy and shall have aspect ratios less than or equal to 4-to-1 for Life Safety and 3-to-1 for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)

C NC N/A NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 feet and shall have span/depth ratios less than 4-to-1. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)

C NC N/A OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec. 4.5.7.1)

Connections

C NC N/A STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)

C NC N/A BEAM, GIRDER, AND TRUSS SUPPORTS: Beams, girders, and trusses supported by unreinforced masonry walls or pilasters shall have independent secondary columns for support of vertical loads. (Tier 2: Sec. 4.6.4.5)

Appendix C: Summary Data Sheet

BUILDING DATA

Building Name: Everett YMCA - 1960's Portion Date:

Building Address: 2720 Rockefeller Ave

Latitude: 48 Longitude: 122 By: RMF

Year Built: 1960 Year(s) Remodeled: Addition in 1980 Original Design Code:

Area (sf): 12,000 ft² Length (ft): 69' Width (ft): 48'

No. of Stories: 3 + basement Story Height: ~10' Total Height: 46'

USE ☐ Industrial ☐ Office ☐ Warehouse ☐ Hospital ☐ Residential ☒ Educational ☐ Other:

CONSTRUCTION DATA

Gravity Load Structural System: Wood Roof supported on conc and stl cols, concrete framing at floors

Exterior Transverse Walls: CMU walls, conc walls at base Openings? Minor

Exterior Longitudinal Walls: " Openings? Many

Roof Materials/Framing: 4" decking on glulam beams supported on CMU and stl cols

Intermediate Floors/Framing: 5½" conc slab on conc bms supported on conc cols

Ground Floor: conc SOG

Columns: stl WF cols and rect conc cols Foundation: Spread ftgs

General Condition of Structure:

Levels Below Grade? 1 story basement under bldg

Special Features and Comments: Cols on south side not cont. to foundation, supported on concrete transfer girders

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System:	Conc walls at basement, CMU above	Same as longit.
Vertical Elements:		
Diaphragms:	4" deck Roof, 5½" conc floor slab	same as longit
Connections:		

EVALUATION DATA

Spectral Response Accelerations: S_s= 0.61 S_1= 0.196

Soil Factors: Class= C (assume) F_a= 1.16 F_v= 1.6

Design Spectral Response Accelerations: S_{DS}= 0.706 S_{D1}= 0.313

Level of Seismicity: High Performance Level: Life Safety

Building Period: T= 0.353 sec

Spectral Acceleration: S_a= 0.706

Modification Factor: C= 1.0 Building Weight: W= 2152 k

Pseudo Lateral Force: $V=CS_aW$= 1520 k

BUILDING CLASSIFICATION: RM1 at Roof, RM2 at floors, C2 at 1st Floor

REQUIRED TIER 1 CHECKLISTS

	Yes	No
Basic Structural Checklist	☒	☐
Supplemental Structural Checklist	☒	☐
Geologic Site Hazards and Foundations checklist	☐	☐
Basic Nonstructural Component Checklist	☐	☐
Intermediate Nonstructural Checklist	☐	☐
Supplemental Nonstructural Checklist	☐	☐

FURTHER EVALUATION REQUIREMENT:

Appendix C: Summary Data Sheet

BUILDING DATA

Building Name: Everett YMCA - 1920's Portion Date: ______
Building Address: 2720 Rockefeller Ave
Latitude: 48 Longitude: 122 By: RMF
Year Built: 1920 Year(s) Remodeled: Additions in 60's & 80's Original Design Code: ______
Area (sf): 31,500 sf Length (ft): 115' Width (ft): 100'
No. of Stories: 4 + basement Story Height: ~10' Total Height: 54.5'

USE

☐ Industrial ☐ Office ☐ Warehouse ☐ Hospital ☐ Residential ☒ Educational ☐ Other: ______

CONSTRUCTION DATA

Gravity Load Structural System: Wood Roof supported on int & ext. bearing walls & int. cols.
Exterior Transverse Walls: 12" Brick, 16" Brick & 19" conc walls Openings? YES
Exterior Longitudinal Walls: 12" Brick, 16" Brick & 19" conc walls Openings? YES
Roof Materials/Framing: 4" T&G on wood trusses, 4" T&G on bearing walls
Intermediate Floors/Framing: 4" T&G on beams at lvls 3-5, Concrete slab on conc beams at lvl 2
Ground Floor: concrete
Columns: wood post, steel pipes, conc cols Foundation: Assume strip/spread ftgs
General Condition of Structure: ______
Levels Below Grade? 1
Special Features and Comments: Portion of 2nd floor conc slab raised at East face

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System:	Conc walls at basement, Brick walls above	Same as longit
Vertical Elements:		
Diaphragms:	4" deck	
Connections:		

EVALUATION DATA

Spectral Response Accelerations: S_s= 0.610 S_1= 0.196
Soil Factors: Class= C (assume) F_a= 1.16 F_v= 1.60
Design Spectral Response Accelerations: S_{DS}= 0.706 S_{D1}= 0.313
Level of Seismicity: High Performance Level: life safety
Building Period: T= 0.401 sec
Spectral Acceleration: S_a= 0.706
Modification Factor: C= 1.0 Building Weight: W= 3303 k
Pseudo Lateral Force: $V=CS_aW$= 2332 k

BUILDING CLASSIFICATION: URM : Unreinforced Masonry w/ Flex diaphragm

REQUIRED TIER 1 CHECKLISTS

	Yes	No
Basic Structural Checklist	☒	☐
Supplemental Structural Checklist	☒	☐
Geologic Site Hazards and Foundations checklist	☐	☐
Basic Nonstructural Component Checklist	☐	☐
Intermediate Nonstructural Checklist	☐	☐
Supplemental Nonstructural Checklist	☐	☐

FURTHER EVALUATION REQUIREMENT: ______

Appendix C: Summary Data Sheet

BUILDING DATA

Building Name: Everett YMCA – 1980's Portion Date: ______
Building Address: 2720 Rockefeller
Latitude: 48 Longitude: 122 By: ______
Year Built: 1980 Year(s) Remodeled: ______ Original Design Code: UBC 1976
Area (sf): 43,400☐' Length (ft): 130' Width (ft): 120'
No. of Stories: 3 + basement Story Height: varies ~10' or 24' Total Height: 63'

USE ☐ Industrial ☐ Office ☐ Warehouse ☐ Hospital ☐ Residential ☒ Educational ☐ Other: ______

CONSTRUCTION DATA

Gravity Load Structural System: 2½" conc on 1½" deck over on OWSJ and stl bms supported on CMU walls or stl cols
Exterior Transverse Walls: CMU walls, conc walls at base Openings? minor
Exterior Longitudinal Walls: CMU walls, conc walls at base Openings? minor
Roof Materials/Framing: 2½ conc on 1½" deck on OWSJ/stl bms on CMU wall/stl cols
Intermediate Floors/Framing: same as roof
Ground Floor: concrete SOG
Columns: TS cols Foundation: spread/strip ftgs
General Condition of Structure: ______
Levels Below Grade? 1 story basement
Special Features and Comments: There is a track along bldg roof perimeter that is covered by 3" mtl deck canopy supported on TS cols & CMU walls

LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System:	CMU shear walls, conc shear walls @ base	same as longit
Vertical Elements:		
Diaphragms:	2½" conc on 1½" deck	same as longit
Connections:		

EVALUATION DATA

Spectral Response Accelerations: S_s= 0.61 S_1= 0.196
Soil Factors: Class= C (assume) F_a= 1.16 F_v= 1.60
Design Spectral Response Accelerations: S_{DS}= 0.706 S_{D1}= 0.313
Level of Seismicity: High Performance Level: Life Safety
Building Period: T= 0.447 sec
Spectral Acceleration: S_a= 0.701
Modification Factor: C= 1.0 Building Weight: W= 5293[k]
Pseudo Lateral Force: $V=CS_aW$= 3708[k]

BUILDING CLASSIFICATION: RM2: CMU walls w/stiff diaphragms

REQUIRED TIER 1 CHECKLISTS

	Yes	No
Basic Structural Checklist	☒	☐
Supplemental Structural Checklist	☒	☐
Geologic Site Hazards and Foundations checklist	☐	☐
Basic Nonstructural Component Checklist	☐	☐
Intermediate Nonstructural Checklist	☐	☐
Supplemental Nonstructural Checklist	☐	☐

FURTHER EVALUATION REQUIREMENT: ______

List of Calculations

1920 Building

Building Seismic Weight.. A1

FEMA-310 Base Shear Calculations.. A6

Shear Stress Check.. A8

Height-to-thickness Check of Walls.. A10

1960 Building

Building Weight.. B1

FEMA-310 Base Shear Calculations.. B5

Shear Stress Check.. B6

Wall Reinforcing Check.. B8

Wall to Diaphragm Connection Check.. B9

Deflection Compatibility.. B10

1980 Building

Building Weight.. C1

FEMA-310 Base Shear Calculations.. C8

Shear Stress Check.. C9

Wall Reinforcing Check.. C13

Wall to Diaphragm Connection Check.. C14

1920's Bldg

Flat Loads:

Roof (at gym):

Roofing	10 psf
4" T&G	8 psf
Wood Trusses	10 psf
Misc/MEP	3 psf
	31 psf

Roof:

Roofing	10 psf
4" T&G	8 psf
joists/bm	5 psf
Posts	2 psf
Partitions	7 psf
Misc/MEP	3 psf
	35 psf

Floors 3*, 4 & 5:

Ceiling/Flooring	5 psf
4" T&G	8 psf
joists/bms	5 psf
Posts	2 psf
Partitions	15 psf
Misc/MEP	3 psf
	38 psf

* Note: at gym floor on 3rd Flr add 10 psf for additional flooring

Project: Everett YMCA   Designed By: RMF Date 3/11/04

Project No: Client: Checked By: Sheet A1 of

1920's BLDG

Flat Loads:

2nd Floor*:

Flooring / Ceiling	5 psf
5½" conc slab	69 psf
Conc bms	20 psf
Conc Cols	4 psf
Partitions (CMU partitions)	20 psf
MEP / Misc	3 psf
	121 psf

* Note: The thickness of the slab & the wt of the bms are unknown. The weight was assumed based on wt of slab & bms in 60's bldg.

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1920's Bldg

Wall Wt:

Roof: Brick does not continue to roof level

5th Floor: 12" brick + 1" plaster
Assume wt is 110 psf vertical

$$\text{wall wt} = 110\text{psf} \times (115' + 100' + 100' + 34' + 14') \times \left(\frac{10'}{2} + 1'\right)$$

Parapet on North Face → $+\ 110\text{psf} \times (45' + 16') \times \left(\frac{10'}{2} + 5'\right)$

$$= 240^k + 67^k = 307^k$$

4th Floor: 12" brick + 1" plaster

$$\text{wall wt} = 0.8 \times 110\text{psf} \times (115' + 100' + 100' + 34' + 14' + 45' + 16') \times \left(\frac{10}{2} + \frac{10.5}{2}\right)$$

assume for windows

$$= 382^k$$

3rd Floor: 12" brick + 1" plaster above 3rd Floor
16" brick + 1" plaster below 3rd Floor
assume 16" brick + 1" plaster wt is 150 psf

$$\text{wall wt} = 382^k/2$$

assume for windows

$$+\ 0.7 \times 150\text{psf} \times (115' + 100' + 100' + 34' + 14' + 45' + 16') \times \left(\frac{14'}{2}\right)$$

$$= 191^k + 312^k = 503^k$$

2nd Floor: 16" brick + 1" plaster above 2nd Floor
19" conc below 2nd Floor (wt is 240 psf)

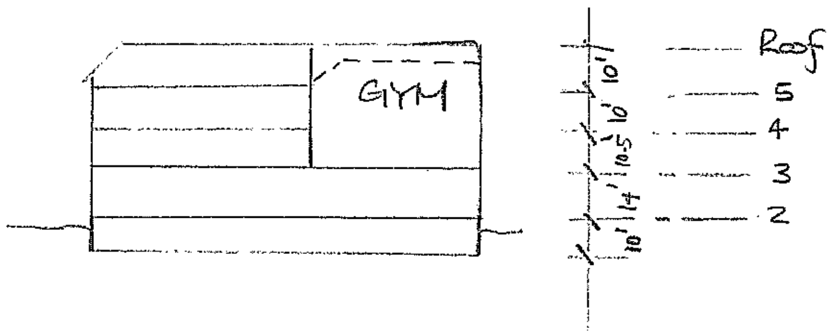
$$\text{wall wt} = 312^k$$

$$+\ 0.7 \times 240\text{psf}(115' + 100' + 100' + 34' + 14' + 45' + 16') \times \left(\frac{10'}{2}\right)$$

$$= 312^k + 356^k = 668^k$$

1920's BLDG

Calculate Seismic Wt :



Area at 2^{st} & 3^{rd} Floors :

100' x 100' + 15' x 45' = 10,645□'

Area at 4^{th} Floor :

$10{,}645□' - \underbrace{45' \times 82'}_{\text{gym area}} - \underbrace{10' \times 68}_{\text{open court}} = 6305□'$

Area at 5^{th} Floor :

14'x67' = 938□' ← Roof area btwn courtyard & gym

45'x82' = 3690□ ← gym roof

6305□' - 938□' = 5367□' Floor area on 5^{th} Floor

Roof = 5367□'

1920's Bldg

Calculate Seismic Wt:

Roof Wt $= 5367^{\square'} \times 35\text{psf} = 188^k$

5th Flr Wt $= 938^{\square'} \times 35\text{psf} = 33^k$
$+ 3690^{\square'} \times 31\text{ psf} = +114^k$
$+ 5367^{\square'} \times 38\text{ psf} = +204^k$
$+ 307^k = +307^k$
$= 658^k$

4th Flr Wt $= 6305^{\square'} \times 38\text{ psf} = 240^k$
$+ 382^k = +382^k = 622^k$

3rd Flr Wt $= 10{,}675^{\square'} \times 38\text{psf} = 406^k$
$+ 503^k = +503^k = 909^k$

2nd Flr Wt $= 10{,}675^{\square'} \times 121\text{ psf} = 1292^k$
$+ 668^k = +668^k = 1960^k$

4337^k

1920's Bldg

Pseudo Lateral Seismic Force--ASCE 31-03 Section 3.5.2

Performance Level: Life-Safety
Seismicity Level: High
Class C (from page 3-12) (assumed)
C = 1.00 (Table 3-4) ↖ see following page

Acceleration based on 10% in 50yr probabilities per C3.5.2.3.1

S_1 = 0.195839 (from USGS website 1 sec period) F_v = 1.60 (Table 3-5)
S_s = 0.610858 (from USGS website 0.2 sec period) F_a = 1.16 (Table 3-6)
C_t = 0.02 other β = 0.75 (3.5.2.4)
h_n = 54.5 ft

Calculations

S_{D1} = 0.313342 w/o 2/3 (3-5) k = 1.000
S_{Ds} = 0.706152 w/o 2/3 (3-6)
T = 0.401 secs (3-7)
S_a = 0.706152 (3-4)

V = 3063 kips (3-1)

Floor	**h_i (ft)**	**w_i (kip)**	**h_i^k**	**$w_i*h_i^k$**	**C_{vx}**	**F_x**	**V_j**	**F_x*h_i**
Roof	54.5	188	54.50	10246	0.1001	306	306	16701
5	44.5	658	44.50	29281	0.2859	876	1182	38969
4	34.5	622	34.50	21459	0.2096	642	1824	22142
3	24	909	24.00	21816	0.2130	652	2476	15659
2	10	1960	10.00	19600	0.1914	586	3063	5862
	Sum	4337		102402	1.0000	3063		99332
						= ?		
						3063		

A6

Reina Farah

Subject: YMCA Everett - seismic soils classification & YMCA standards

From: Marc Everson [mailto:marc@gly.com]
Sent: Monday, March 15, 2004 6:40 PM
To: jclark@zgf.com; Steven Savage; scottd@earthci.com
Cc: jking@psfmech.com; Katrina Corbett; Roger Anderson; Dennis Maples
Subject: YMCA Everett - seismic soils classification & YMCA standards

Jane & Steve,
A couple of follow up items. Regarding the seismic soils classification for the area that would likely represent the Everett YMCA. I spoke to Scott Dinkelman of ECI - Earth Consultants, Inc., and from reports they have in the area the soils would be classified as Sc (S sub c) very dense soils or soft rock. The soils are very dense.

Also I spoke to both Roger & Dennis of our office regarding YMCA standards. The YMCA has design standards including Architectural, Mechanical, Electrical, etc., however all of our experience with the Y indicates that locally the standards are not used at all because they're not applicable and other not written standards have been effectively adopted. Dennis Maples has a copy of these standards and if you'd like to see them please let him know via return reply to this e-mail but again effectively they're not used.

Scott,
Thanks for the soils classification information.

Thanks! - Marc

Earthquake Hazards Program

The input zip-code is 98201.

ZIP CODE	98201
LOCATION	47.9872 Lat. -122.2003 Long.
DISTANCE TO NEAREST GRID POINT	1.4198 kms
NEAREST GRID POINT	48.0 Lat. -122.2 Long.

Probabilistic ground motion values, in %g, at the Nearest Grid point are:

	10%PE in 50 yr	5%PE in 50 yr	2%PE in 50 yr
PGA	27.609020	37.358440	51.844090
0.2 sec SA	61.085770 ← S_s	93.750076	121.920502
0.3 sec SA	54.795750	76.709190	114.815498
1.0 sec SA	19.583139 ← S_1	27.122950	38.870270

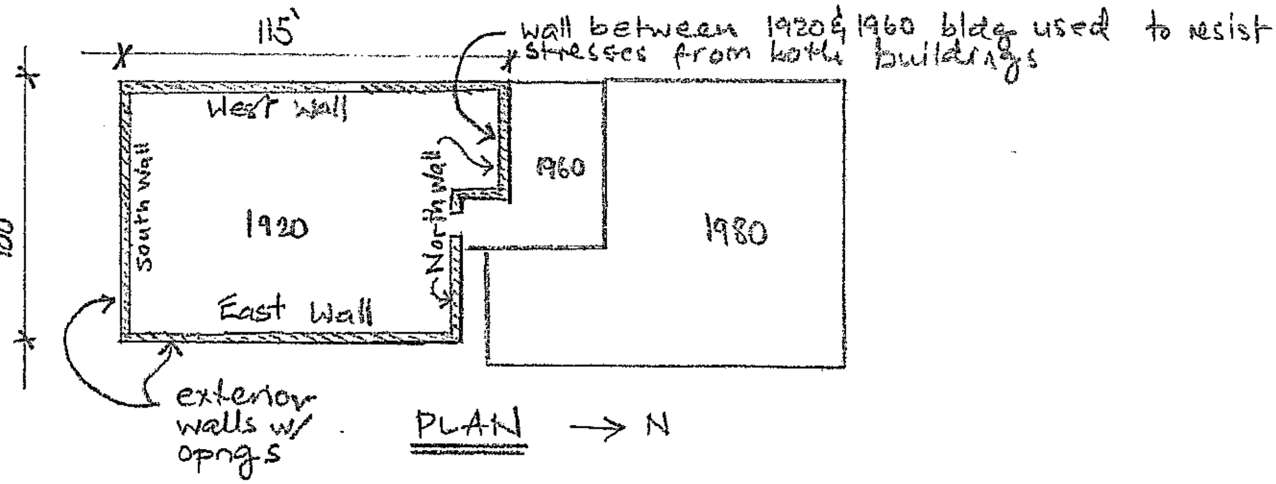
The input zip-code is .
Zip code is zero and we go to the end and stop.

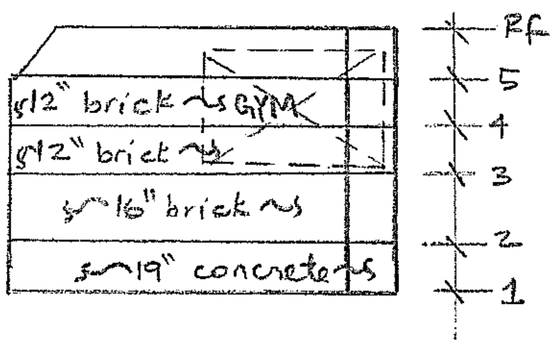
PROJECT INFO: Home Page
SEISMIC HAZARD: Hazard by Zip Code

A7

1920's Bldg

Check URM shear stresses :





Elevation of 20's Portion
showing wall thickness & material

Check North & South Walls since they have less length than East & West Walls. However, since North wall shares load with 1960's bldg, see calcs of 1960's bldg for check of North wall shear stresses.

Check South Wall below 4th level (12" brick), below 3rd Level (16" brick) and below 2nd Level (19" concrete)

1920's Bldg

Check URM shear stresses:

- South Wall Check below 4^{th} level (12" brick):

  Wall length = 2 end piers × 8.5' + 10 int. piers × 5'
  = 67' not including windows

  $A_W = 67' \times 12 \times 12''$ thick $= 9648^{\square''}$

  $V_4 = 1824^k$

  $v_{4\,avg} = \frac{1}{m}\left(\frac{V_4}{A_W}\right) = \frac{1}{1.5}\left(\frac{1824^k/2\text{ walls}}{9648^{\square''}}\right) = 63$ psi > 30psi NG

- South wall check below 3^{rd} level (16" brick):

  Wall length = 2 end piers × 10.5' + 6 int. piers × 5.5'
  = 54'

  $A_W = 54' \times 12 \times 16''$ thick $= 10{,}368^{\square''}$

  $V_3 = 2476^k$

  $v_{3\,avg} = \frac{1}{m}\left(\frac{V_3}{A_W}\right) = \frac{1}{1.5}\left(\frac{2476^k/2\text{ walls}}{10{,}368^{\square''}}\right) = 80$psi > 30psi NG

- South Wall Check below 2^{nd} Level (19" conc wall)

  Use same wall length as above

  $A_W = 54' \times 12 \times 19''$ thick $= 12{,}312^{\square''}$

  $V_2 = 3063^k$

  $v_{2\,avg} = \frac{1}{4}\left(\frac{3063/2\text{ walls}}{12{,}312^{\square''}}\right) = 31$ psi < 100 psi ∴ OK

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Project: Everett YMCA | Designed By: RMF | Date 3/11/04

Project No: | Client: | Checked By: | Sheet A9 of

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1920's BLDG

- Check ht-to-thickness ratio of shear walls

First story : $ht = 14'$

$h/t = \frac{14'}{13''/12} = 12.9 < 15$ ok

Top story : $ht = 9.5'$

$h/t = 9.5'/13''/12 = 8.46 < 9$ ok

Other Stories : $ht = 10.5'$

$h/t = 10.5'/13''/12 = 9.69 < 13$ ok

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1960's Bldg

Flat Loads :

Roof

Roofing	5 psf
4" T&G	8 psf
GLB's @ 14' oc	6 psf
Conc Cols	4 psf
MEP / Misc	4 psf
	27 psf

Typ floor :

Flooring/Ceiling	3 psf
5½" conc slab	69 psf
Conc bms	20 psf
Conc col	4 psf
MEP/Misc	4 psf
	100 psf

+ at gym Floor add 10 psf for flooring

1960s Bldg

Walls (8", 10" & 12" CMU)

Use 10" CMU walls at 100 psf vertical to estimate wt of walls

windows

Roof : $100\text{psf} \times 0.8 \times (69' + 48' + 48') \times \frac{22.5'}{2}$

$+ 100\text{psf} \times (16' + 6' + 12') \times (10' + \frac{10'}{2})$

$+ 35\text{psf} \times 48' \times \frac{22.5'}{2}$ ← 4" brick on West wall

$= 149^k + 51^k + 19^k = 219^k$

3rd Floor : $100\text{psf} \times (20' + 9' + 9') \times (10' + \frac{10'}{2})$

$+ 100\text{psf} \times (16' + 6' + 12') \times (10')$

$= 57^k + 34^k = 91^k$

2nd Floor : $100\text{psf} \times 0.8 \times (69' + 48' + 48') \times (\frac{22.5'}{2} + \frac{10'}{2})$

$+ 100\text{psf} \times (16' + 6' + 12') \times 10'$

8" CMU partition walls → $+ 80\text{psf} \times (69' + 69' + 48' + 48') \times \frac{10'}{2}$

$+ 100\text{psf} \times (20' + 9' + 9') \times (10')$

4" brick on west wall → $+ 35\text{psf} \times 48' \times (\frac{22.5}{2} + \frac{10}{2})$

$= 215^k + 34^k + 94^k + 38^k + 27^k = 408^k$

1st Floor : $100\text{psf} \times 0.8 \times (69' + 48' + 48') \times (\frac{10' + 14'}{2})$

$+ 100\text{psf} \times (16' + 6' + 12')(\frac{10' + 14'}{2})$

$+ 100\text{psf} \times (20' + 9' + 9') \times (\frac{10' + 14'}{2})$

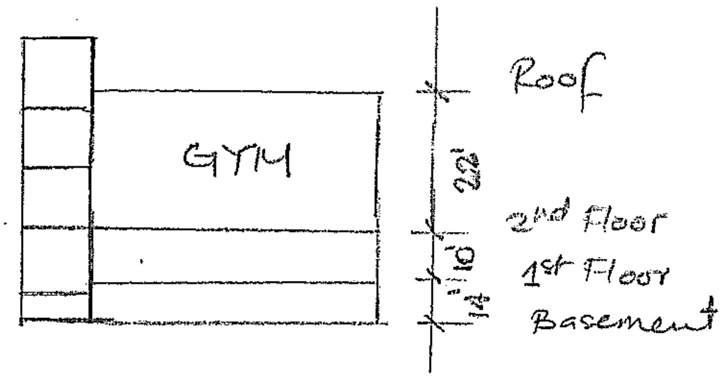
$+ 80\text{psf} \times (69' + 69' + 48' + 48') \times (\frac{10' + 14'}{2})$

$+ 35\text{psf} \times 48' \times (10/2 + 4')$

$= 158^k + 41^k + 46^k + 225^k + 15^k = 485^k$

1960's Bldg

Calculate Seismic Wt:



Area At Roof: 48' × 69' + 15' × 25' + 20' × 9'
= 3312□' + 375□' + 180□' = 3867□'

Area at 3rd Floor:
375□'

Area at 2nd Floor: 3867□'

Area at 1st Floor: 3867□'

Total = 11,976□'

1960's Bldg

Calculate Seismic Wt:

Roof = $3864^{\square'} \times 27\,psf + 219^k = 323^k$

3rd Flr = $375^{\square'} \times 100\,psf + 91^k = 129^k$

2nd Flr = $3867^{\square'} \times 100\,psf + 10\,psf \times 69' \times 48' + 408^k = 828^k$

1st Flr = $3867^{\square'} \times 100\,psf + 485^k = 872^k$

2152^k

1960's Bldg

<u>**Pseudo Lateral Seismic Force--ASCE 31-03**</u> Section 3.5.2

Performance Level: Life-Safety
Seismicity Level: High
Class C (from page 3-12) (assumed)
$C =$ 1.00 (Table 3-4)

Accelerations based on 10% in 50yr probabilities per C3.5.2.3.1

$S_1 =$ 0.195839 (from USGS website 1 sec period) $F_v =$ 1.60 (Table 3-5)
$S_s =$ 0.610858 (from USGS website 0.2 sec period) $F_a =$ 1.16 (Table 3-6)
$C_t =$ 0.02 other $\beta =$ 0.75 (3.5.2.4)
$h_n =$ 46 ft

Calculations

$S_{D1} =$ 0.313342 w/o 2/3 (3-5) k = 1.000
$S_{Ds} =$ 0.706152 w/o 2/3 (3-6)
$T =$ 0.353 secs (3-7)
$S_a =$ 0.706152 (3-4)

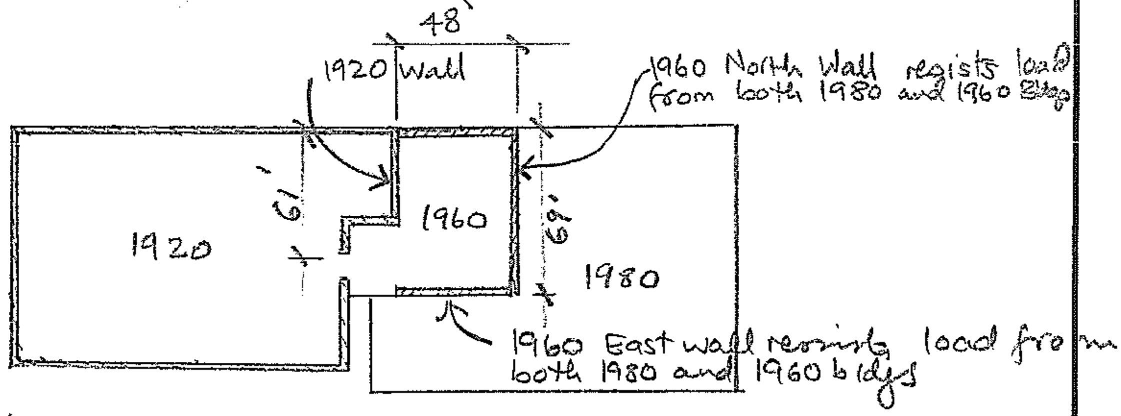
V = 1520 kips (3-1)

Floor	h_i (ft)	w_i (kip)	h_i^k	w_i*h_i^k	C_{vx}	F_x	V_j	F_x*h_i
Roof	46	323	46.00	14858	0.2891	439	439	20211
3	34.5	129	34.50	4451	0.0866	132	571	4540
2	24	828	24.00	19872	0.3867	588	1159	14104
1	14	872	14.00	12208	0.2376	361	1520	5054
	Sum	2152		51388.5	1.0000	1520		43909
						= ?		
						1520		

B5

1960s Bldg

Check CMU/conc wall shear stresses



PLAN → N

In transverse direction, there are 2 CMU walls.

In longit direction, loads are resisted by 1920 wall and 1960 North Wall. For check of stresses in 1960 North & East wall, see 1980 calcs since they resist load in 1980 bldg.

- Check walls in transverse direction (West wall)

At first floor: wall is 8" conc

$\ell_w = 48' - 8'\text{ opng} = 40'$

$A_w = 40' \times 12 \times 8'' = 3660^{\square''}$

$V = 1520^k$

$v_{avg} = \frac{1}{m}\frac{V}{A_w} = \frac{1}{4.0} \times \frac{1520^k / 2\text{ walls}}{3660^{\square''}} = 52\text{ psi} < 100\text{ psi} \therefore \text{ok}$

At 2nd Floor: wall is 8" CMU

$A_w = (48' - 8') \times 12'' \times 5.2'' = 2496\text{ in}^2$

$V = 1159^k$

$v_{avg} = \frac{1}{m}\frac{V}{A_w} = \frac{1}{4.0} \times \frac{1159^k / 2\text{ walls}}{2496} = 58\text{ psi} < 70\text{ psi} \therefore \text{ok}$

1960s Bldg

Check CMU / conc Wall shear Stresses

- Check Walls in Longit direction

- 1920 wall at 3rd Level is 13" brick

$$V_{wall} = \frac{571^k}{2\text{ walls}} + \frac{1824^k}{2\text{ walls}} \times \frac{61'}{100'}$$

1960s   1920s   length of wall common to both bldgs   total length of wall

$$= 286^k + 556^k$$

$$= 842^k$$

$$l_w = 61'$$

$$A_w = 61' \times 12 \times 13'' = 9516^{\square''}$$

$$v_{avg} = \frac{1}{m}\frac{V}{A_w} = \frac{1}{1.5} \times \frac{842^k}{9516^{\square''}} = 60\text{ psi} > 30\text{ psi} \therefore NG$$

- 1920 wall at 2nd level is 16" brick

$$V_{wall} = \frac{1159^k}{2\text{ walls}} + \frac{2476^k}{2\text{ walls}} \times \frac{61'}{100'}$$

$$= 580^k + 755^k$$

$$= 1335^k$$

$$A_w = 61' \times 12 \times 16'' = 9516^{\square''}$$

$$v_{avg} = \frac{1}{m}\left(\frac{V}{A_w}\right) = \frac{1}{1.5} \times \frac{1335^k}{9516^{\square''}} = 94\text{ psi} > 30\text{ psi} \therefore NG$$

- 1920 wall at 1st Floor is 19" conc

$$V_{wall} = \frac{1520^k}{2\text{ walls}} + \frac{3063^k}{2\text{ walls}} \times \frac{61'}{100'}$$

$$= 760^k + 934^k = 1694^k$$

$$A_w = 61' \times 12 \times 19'' = 13908^{\square''}$$

$$v_{avg} = \frac{1}{4.0}\left(\frac{V}{A_w}\right) = \frac{1}{4.0}\left(\frac{1694^k}{13908^{\square''}}\right) = 30\text{ psi} < 100\text{ psi} \therefore OK$$

1960's Bldg

Check Wall Reinforcing Ratios in CMU:

10" CMU : #6 bars @ 24" oc Vertical
K web reinf @ 24" oc horiz (assume 2 wires 10ga)

$$\rho_v = \frac{0.44 in^2}{24" \times 9.625"} = 0.002$$

$$\rho_H = \frac{2 \times (0.135)^2 \pi/4}{24" \times 9.625"} = 0.000124 < 0.0007$$

∴ N.G.

$\rho_v + \rho_H > 0.002$ ∴ OK

8" CMU : #5 @ 24" oc
K-web reinf, assume @ 24" oc horiz

$$\rho_v = \frac{0.31 in^2}{24" \times 7.625"} = 0.0017$$

$$\rho_H = \frac{2 \times (0.135)^2 \pi/4}{24" \times 7.625"} = 0.000156$$

$\rho_v + \rho_H = 0.0019 \sim 0.002$

Check wall Reinforcing Ratios in concrete:

10" conc wall → Vert. #4 @ 12"
horiz. #4 @ 12"

$$\rho_H = \rho_v = \frac{0.2}{10" \times 12"} = 0.00167 > 0.0015 \text{ for Vert}$$
< 0.0025 for horiz

try 8" conc wall w/ #4 @ 12" oc

$$\rho_H = \frac{0.2 in^2}{8" \times 12"} = 0.00208 < 0.0025$$

N.G. for horiz reinf

Project: Everett YMCA Designed By: RMF Date 4/8/04
Project No: Client: Checked By: Sheet 88 of

1960's Bldg

Diaphragm Connection Forces
Btwn wood diaphragm at Roof & CMU walls

$T_c = ? S_{DS} w_p A_p = 0.9 \times 0.706 \times 100\text{psf} \times 40^{\square'}$
$= 2542^{\#}$

$? = 0.9$ for L.S.

$S_{DS} = 0.706$

$w_p = 100$ psf (10" CMU)

$A_p = \frac{20'}{2} \times 4' = 40^{\square'}$

Typical detail shows decking attached to CMU walls w/ ½" ϕ bolts @ 48" oc (ref details on sheet 11)

½" ϕ bolt Capacity $= 3.1^k \times 1.7 = 5.27^k > 2.542^k$

∴ OK

1960's Bldg

Deformation Compatibility

12" x 16" col w/ 6 #8 vert & #3 ties @ 18" oc

Check Strong axis bending:

$\phi V_c = 0.85 \times 2\sqrt{3000} \times 12" \times 16" = 18^k$

assume

$\phi V_s = 0.85 \times 2 \times 0.11 in^2 \times 40 ksi \times \frac{14"}{18"} = 6^k$

$\phi V_n = 18^k + 6^k = 24^k$

Load on Col: 151^k from column schedule in Existing dwgs sheet 13

Calculate Load:

Rf, Lvl 3, Lvl 2, partitions

$P_D = 14' \times \frac{48'}{2} \times [27psf + 110psf + 100psf + 40psf] = 93^k$

$P_L = 14' \times 48/2 \times [25psf + 100psf + 40psf] \times 0.6 = 33^k$

LL Red.

$P = 126^k$

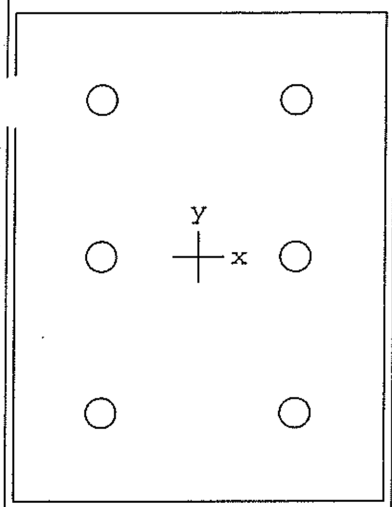
$\therefore P = 151^k$ ← Use load from dwgs since greater than 126^k

$P_u = 1.55 \times 151^k = 234^k$

$M_u = 97$ k-ft

$V_u = \frac{2 M_u}{L'} = \frac{2 \times 97 \text{ k-ft}}{10' - 2'} = 24^k$

$DCR = \frac{24^k}{24^k} = 1.0 \quad \therefore OK$



12 x 16 in

Code: ACI 318-95

Units: English

Run axis: About X-axis

Run option: Investigation

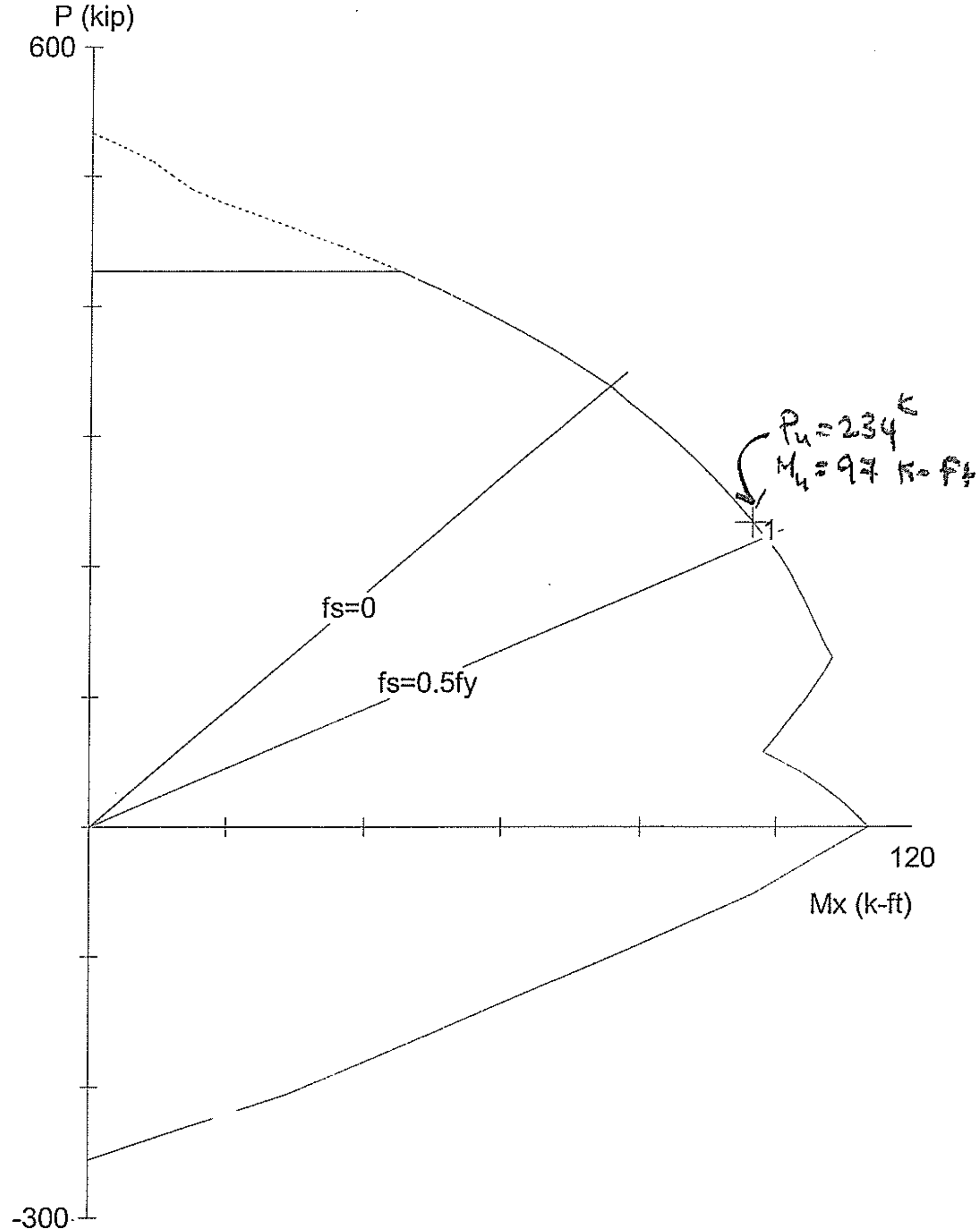
lenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 03/15/04

Time: 09:54:17



PCACOL V3.00 (PCA 1999) - Licensed to: Coughlin Porter Lundeen, Seattle, WA

File: C:\PROGRA~1\PCACOL\DATA\COL60S.COL

Project: deformation compatibility

Column: 1st flr col		Engineer: RMF	
f'c = 3 ksi	fy = 60 ksi	Ag = 192 in^2	6 #8 bars
Ec = 3122 ksi	Es = 29000 ksi	As = 4.74 in^2	Rho = 2.47%
fc = 2.55 ksi	e_rup = Infinity	Xo = 0.00 in	Ix = 4096 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 2304 in^4
Beta1 = 0.85		Clear spacing = 4.12 in	Clear cover = 2.37 in

B11

General Information:
====================
File Name: C:\PROGRA~1\PCACOL\DATA\COL60S.COL
Project: deformation compatibility
Column: 1st flr col — Engineer: RMF
Code: ACI 318-95 — Units: English

Run Option: Investigation — Slenderness: Not considered
Run Axis: X-axis — Column Type: Structural

Material Properties:
====================
f'c = 3 ksi — fy = 60 ksi
Ec = 3122.02 ksi — Es = 29000 ksi
fc = 2.55 ksi — Rupture strain = Infinity
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========
Rectangular: Width = 12 in — Depth = 16 in

Gross section area, Ag = 192 in^2
Ix = 4096 in^4 — Iy = 2304 in^4
Xo = 0 in — Yo = 0 in

Reinforcement:
==============
Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.7

Layout: Rectangular
Pattern: Sides Different (Cover to transverse reinforcement)
Total steel area, As = 4.74 in^2 at 2.47%

	Top	Bottom	Left	Right
Bars	2 # 8	2 # 8	1 # 8	1 # 8
Cover(in)	2	2	2	2

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
==

No.	Pu kip	Mux k-ft	fMnx k-ft	fMn/Mu
1	234.0	96.5	96.5	1.000

*** Program completed as requested! ***

BfZ

1980's Bldg

ROOF ABOVE TRACK & TOP OF STAIRWAYS :

ROOFING	3 psf
3" MTL DECK	3 psf
Stl bms / cols	5 psf
MISC / MEP	3 psf
	14 psf

ROOF Below track :

Roofing	5 psf
ceiling	5 psf
2½" conc over 1½" deck	40 psf
joists @ 5'-4" oc	5 psf
Cols	3 psf
Partitions	7 psf
MEP / Misc	4 psf
	69 psf

ROOF elsewhere :

Roofing	5 psf
Ceiling	5 psf
3" mtl deck	3 psf
stl bms / cols	6 psf
Misc / MEP	5 psf
	24 psf

Project: Everett YMCA Designed By: RMR Date 3/4/04

Project No: Client: Checked By: Sheet C1 of

1980's Bldg

- 4th Floor

Flooring / ceiling	8 psf
2½" conc over 1½" deck	40 psf
Joists at 5'-4" oc	5 psf
Cols	3 psf
Partitions	15 psf
Misc / MEP	3 psf
	74 psf

- 3rd Floor

Flooring / Ceiling	8 psf
2½" conc over 1½" deck	40 psf
stl bms	5 psf
Cols	3 psf
PARTITIONS	15 psf
MISC/MEP	3 psf
	74 psf

1980's BLDG

– 2nd FLOOR

FLOORING / ceiling	8 psf
2½" conc over 1½" deck	40 psf
joists @ 5'-4"	5 psf
Cols	2 psf
Partitions	15 psf
Misc / MEP	3 psf
	73 psf

plus at gym floor add 10 psf for flooring

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1980's Bldg

Wall Wt :

Roof : Walls that go to track Roof (8" CMU)

$80\text{psf} \times (77' + 22' + 19' + 10' + 19' + 19') \times (10' + \frac{24'}{2})$

$= 292^k$

Walls that do not go to track Roof (10" CMU)

$100\text{psf} \times (56' + 120' + 108' + 30') \times (4' + \frac{24'}{2})$

$= 502^k$

Total $= 694^k$

4th Floor : 8" CMU wall below :

$80\text{ psf} \times (40' + 15' + 15') \times (\frac{15'}{2})$

$= 42^k$

8" CMU wall above & below :

$80\text{psf} \times (69')(\frac{15' + 24'}{2}) = 108^k$

10" CMU wall above & below

$100\text{ psf} \times (100' + 120' + 108')(\frac{15' + 24'}{2})$

$= 640^k$

Total $= 790^k$

3rd Floor :

Only above

8" CMU → $80\text{ psf} \times (108' + 15' + \frac{15'}{2}) \times (\frac{15' + 10'}{2})$

$= 131^k$

10" CMU → $100\text{ psf} \times (100' + 120' + 108')(\frac{15' + 10'}{2})$

$= 410^k$

Total $= 541^k$

Project: Everett YMCA Designed By: RMF Date 3/9/04

Project No: Client: Checked By: Sheet C4 of

1980's Bldg

Wall Wt :

2nd Floor : Walls above only :

10" CMU : $100psf \times (100' + 95') \times \frac{10'}{2} = 98^k$

8" CMU : $80psf \times (85' + 10') \times \frac{10'}{2} = 38^k$

Walls below only:

8" CMU : $80psf \times (74' + 24') \times \frac{14'}{2} = 55^k$

10" conc : $125psf \times (100' + 95') \times \frac{14'}{2} = 171^k$

walls above & below :

10" CMU : $100psf \times (24' + 108')\left(\frac{10' + 14'}{2}\right) = 158^k$

8" CMU : $80psf \times (24') \times \left(\frac{10 + 14}{2}\right) = 23^k$

Total = 543^k

1980's BLDG

Calculate Seismic Wt :

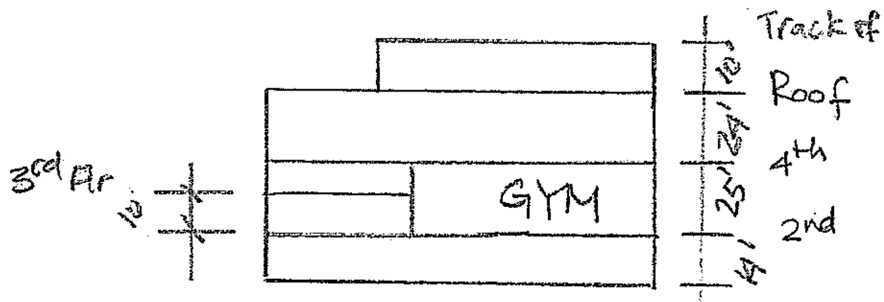
TRACK ROOF AREA & TOP OF STAIRWAY = (12' x 77' + 12' x 95') x 2 + (19' x 9') x 2
= 4128□' + 342□' = 4470□'

ROOF AREA = 77' x 120' + 9' x 19'
= 9240□' + 171□' = 9411□'
plus 55' x 42' = 2310□' Roof area at mech. units (3" untopped deck)

4th Flr Area = 9411□' + 2310□' = 11721□'

3rd Flr Area = 9' x 19' + 22' x 75' + 42' x 45'
= 171□' + 1650□' + 1890□'
= 3711□'

2nd Flr Area = 11,721□' + 10 psf over gym area = 76' x 96' = 7296□'



Area total = 43,344□'

Project: Everett YMCA Designed By: RMF Date 3/4/04
Project No: Client: Checked By: Sheet C6 of

1980's Bldg

calculate Seismic Wt : (lump track Roof wt w/ Rf wt)

Roof : $4470^{\square'} \times 14psf + 9411^{\square'} \times 69psf + 2310^{\square'} \times 24psf$

$= 63^k + 650^k + 55^k + 694^k$ + 694^k ← wall wt

$= 1462^k$

wall wt

4^{th} Floor : $11721^{\square'} \times 74psf + 790^k = 1657^k$

wall wt

3^{rd} Floor : $3711^{\square'} \times 74psf + 541^k = 816^k$

2^{nd} Floor : $11721^{\square'} \times 73psf + 7296^{\square'} \times 10psf + 543^k$

$= 856^k + 73^k + 543^k$ gym floor

$= 1472^k$

Total $= 5407^k$

1980's Bldg

Pseudo Lateral Seismic Force--ASCE 31-03 Section 3.5.2

Performance Level: Life-Safety
Seismicity Level: High
Class C (from page 3-12) (assumed)
$C =$ 1.00 (Table 3-4)

Accelerations based on 10% in 50yr probabilities per C3.5.2.3.1

$S_1 =$ 0.195839 (from USGS website 1 sec period) $F_v =$ 1.60 (Table 3-5)
$S_s =$ 0.610858 (from USGS website 0.2 sec period) $F_a =$ 1.16 (Table 3-6)
$C_t =$ 0.02 other $\beta =$ 0.75 (3.5.2.4)
$h_n =$ 63 ft

Calculations

$S_{D1} =$ 0.313342 w/o 2/3 (3-5) $k =$ 1.000
$S_{Ds} =$ 0.706152 w/o 2/3 (3-6)
$T =$ 0.447 secs (3-7)
$S_a =$ 0.700622 (3-4)

V = 3788 kips (3-1)

Floor	h_i (ft)	w_i (kip)	h_i^k	$w_i*h_i^k$	C_{vx}	F_x	V_j	F_x*h_i
Roof	63	1462	63.00	92106	0.4677	1772	1772	111629
4	39	1657	39.00	64623	0.3282	1243	3015	48484
3	24	816	24.00	19584	0.0995	377	3392	9042
2	14	1472	14.00	20608	0.1047	396	3788	5550
	Sum	5407		196921	1.0000	3788		174705
						= ?		
						3788		

C8

1980's Bldg

- Check Wall shear stresses

- At base in transverse direction (10" CMU)

$$l_{wall} = 109' \text{ (east wall)}$$

$$A_w = 109' \times 6.3" \times 12" = 8240 \square"$$

$$V_{base} = 3788^k$$

$$v_{avg} = \frac{3488^k}{2 \text{ walls}} \times \frac{1}{4.0} \times \frac{1}{8240^{\square"}} = 57\text{psi} < 70\text{psi} \therefore \text{OK}$$

- At base in longit direction:

The shear from the 1980's bldg is resisted by wall in 1960's bldg on North end

Wall is 8" conc and is 69' long

In addition, in 1980 bldg there is a 23' - (5' opng) long 8" CMU wall solid grouted

$$V_{wall} = \frac{\overset{1960s}{1520^k}}{2 \text{ walls}} + \frac{\overset{1980}{3788^k}}{2 \text{ walls}} = 2654^k$$

$$A_w = 69' \times 12" \times 8" + (23' - 5') \times 12 \times 8 =$$
$$= 6624^{\square"} + 1728^{\square"} = 8352^{\square"}$$

$$v_{avg} = \frac{2654^k}{4.0} \times \left(\frac{1}{8352^{\square"}}\right) = 80 \text{ psi} < 100\text{psi} \therefore \text{OK}$$

Project: Everett YMCA Designed By: RMF Date 3/9/04

Project No: Client: Checked By: Sheet C9 of

1980's Bldg

- At 2nd Floor in longit direction (South Wall)

Check wall btwn 1980's and 60's bldg.

Wall is 8" CMU in 80's bldg

$$V_{wall} = \frac{3392^k}{2} = 1696^{k}$$

$$A_w = 69' \times 12" \times 5.2" + (23'-5') \times 7.625" \times 12" = 5953$$

$$v_{avg} = \frac{1696^k}{4.0} \times \frac{1}{5953^{\square"}} = 71 \text{ psi} \sim 70 \text{psi}$$

for CMU

wall is solid grouted ∴ OK

- At 2nd Floor in longit direction (North Wall)

10" stack bond wall.

$$A_{wall} = 118' \times 6.3 \times 12 = 8921^{\square"}$$

$$v_{avg} = \frac{3392^k}{2 \text{ walls}} \times \frac{1}{4} \times \frac{1}{8921^{\square"}} = 48 \text{ psi}$$

- At 2nd Floor in transverse direction

10" stack bond

$$A_{wall} = 91' \times 6.3 \times 12 = 6880^{\square"}$$

$$v_{avg} = \frac{3392^k}{2 \text{ walls}} \times \frac{1}{4} \times \frac{1}{6880^{\square"}} = 62 \text{ psi}$$

1980's Bldg

- At 3rd lvl in traverse direction
  10" stack bond
  $A_{wall} = 91' \times 6.3" \times 12 = 6880\,\square"$
  $v_{avg} = \frac{3015^k}{2 \text{ walls}} \times \frac{1}{4} \times \frac{1}{6880\,\square"} = 55 \text{ psi}$

- At 3rd level in long direction (North Wall)
  $A_{wall} = 118' \times 6.3 \times 12 = 8921\,\square"$
  $v_{avg} = \frac{3015^k}{2 \text{walls}} \times \frac{1}{4} \times \frac{1}{8921\,\square"} = 42 \text{ psi}$

- Check East wall of 1960 Bldg for load from 1980 bldg:
  1960 Bldg shear
  level 2: $V_{wall} = \frac{1159^k}{2} + 3392^k \times 0.1 = 919^k$
  $A_w = 40' \times 12 \times 5.2" = 2496\,\square"$ (assume wall takes 10% of 1980 shear
  $v_{wall} = \frac{919^k}{4} \times \frac{1}{2496\,\square"} = 92 \text{ psi} > 70 \text{ psi}$ NG

  level 3: $V_{wall} = \frac{571^k}{2} + 3015^k \times 0.1 = 587^k$
  $v_{wall} = \frac{587^k}{4} \times \frac{1}{2496\,\square"} = 58 \text{ psi} < 70 \text{ psi}$ ∴ OK

1980 Bldg

Calculate Capacity of 10" stack bond:

– 10" CMU stacked bond

2 – 3/16" φ side Rods @ 24" oc, 2 #5 in bond beam @ 8'-0" oc

$$f_v = \frac{A_v F_s}{bjs} = \frac{0.055\,in^2 \times 20{,}000}{6.3 \times 0.9 \times 24\,in}$$

$$= 8\ psi$$

$$f_v = \frac{A_v F_s}{bjs} = \frac{2 \times 0.31\,in^2 \times 20{,}000}{6.3'' \times 0.9 \times 96''}$$

$$= 23\ psi$$

Allowable capacity for common bond $= 8 + 23 = 31$ psi

Ult capacity $= \frac{31}{2} \times 2.5 = 39$ psi

divide by 2 to get allowable capacity of stack bond

Transverse walls have shear demand greater than 39 psi, further evaluation needed to determine if walls ok.

Project: Everett YMCA Designed By: RMF Date 3/9/04

Project No: Client: Checked By: Sheet C12 of

1980s Bldg

Check Reinforcing Steel:

10" CMU – #5 @ 24" oc vert,
2-3/16" ϕ @ 24" oc & 2 #5 @ 8'-0" oc horiz

$$\rho_V = \frac{0.31 in^2}{24" \times 9.625} = 0.00134 > 0.0007 \text{ ok}$$

$$\rho_H = \frac{2 \times 0.0276 in^2}{24" \times 9.625"} = 0.000239$$

$$+ \frac{2 \times 0.31 in^2}{96" \times 9.625"} = 0.000671$$

$$0.00091 > 0.0007 \therefore \text{ok}$$

$$\rho_{Total} = 0.00134 + 0.00091 = 0.00225 > 0.002 \therefore \text{ok}$$

8" CMU – #5 @ 48" oc Vert
2-3/16" ϕ @ 24" oc & 2 #5 @ 8' oc Horiz

$$\rho_V = \frac{0.31 in^2}{48" \times 7.625"} = 0.000847 > 0.0007 \therefore \text{ok}$$

$$\rho_H = \frac{2 \times 0.0276}{24" \times 7.625"} + \frac{2 \times 0.31}{96" \times 7.625}$$

$$= 0.0003 + 0.000847$$

$$= 0.001147 > 0.0007 \therefore \text{ok}$$

$$\rho_{Total} \doteq 0.002 \therefore \text{ok}$$

1980's bldg

– Wall anchorage

Diaphragm is anchored to CMU using
either 3/4" ϕ AB @ 3'-4" oc OR
#4 x 2'-0" 1'-8" @ 4'-8" oc

Check for 4'-0" trib width of wall

$T_c = ? \, S_{DS} \, w_p \, A_p$

$A_p = 4'\text{-}0" \times 24'$ wall ht $= 96^{\#'}$

$w_p = 100$ psf (10" CMU)

$S_{DS} = 0.706$

$? = 0.9$ for Life Safety

$T_c = 0.9 \times 0.706 \times 100 \text{ psf} \times 96^{\#'}$

$= 6100^{\#}$

Shear capacity of 3/4" ϕ AB $= 8.8^k$ allowable $\times 1.7$
$= 15^k > 6.1^k$

Shear capacity of #4 bar $= 0.2 \text{ in}^2 \times 40$ ksi
$= 8^k > 6.1^k \therefore$ OK

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