STRUCTURAL EVALUATION OF

CRESPI MIDDLE SCHOOL

WEST CONTRA COSTA UNIFIED SCHOOL DISTRICT (WCCUSD)

For

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10.1 Introduction

The purpose of this report is to perform a seismic assessment of the Crespi Middle School in El Sobrante, CA. The structural assessment includes a site walk through and a limited study of available architectural and structural drawings. The purpose of the structural assessment is to identify decay or weakening of existing structural materials (when visible), to identify seismic deficiencies based on our experience with school buildings, and to identify eminent structural life-safety hazards.

The school campus has had a walk-through site evaluation and a limited study of available architectural and structural drawings. The general structural condition of the buildings and any seismic deficiencies that are apparent during our site visit and review of existing drawings are documented in this report. This report includes a qualitative and quantitative evaluation of the buildings. A limited lateral (seismic) numerical analysis was performed to identify deficient lateral elements, which could pose life safety hazards.

The site visits did not include any removal of finishes. Therefore, identification of structural conditions hidden by architectural finishes or existing grade was not performed.

10.2 Description of School

The campus was designed and constructed in two phases beginning in 1964. The first phase produced six permanent buildings. These included three classroom buildings (Unit 2, 3, and 8), the library/administration building (Unit 4), the cafeteria/music building (Unit 5), and a mechanical building (Unit 7). All of these buildings are single story structures. With the exception of the cafeteria/music building, which is of concrete construction, they are also all wood framed structures. In 1965, the second phase of the campus added another single story, wood framed classroom building (Unit 1), and the two-story, concrete gymnasium building (Unit 6). Between the mechanical building and the gymnasium building is a traditional portable building, while another apparent portable structure is sandwiched between the stairwells of the gymnasium building. Neither of the erection dates for these two portables are known. Exclusive of the portable buildings, the total square footage of the permanent structures is approximately 125,000 square feet.

10.3 Site Seismicity

The site is a soil classification S_D in accordance with the 2001 California Building Code (CBC) and as per the consultants, Jensen Van Lieden Associates, Inc.

The classroom buildings and the library/administration building have an educational occupancy (Group E, Division 1 and/or 2), while the gymnasium and cafeteria/music buildings have an assembly occupancy (Group A, Division 1 and 2.1). Both of these have an importance factor in the 2001 CBC of 1.15. The campus is located at a distance of about 3.2 kilometers from the Hayward fault. The wood framed buildings utilize a plywood shear wall system to resist lateral forces. This system has a response modification factor R = 5.5. Conversely, the concrete shear wall buildings have a response modification factor R = 4.5 The 2001 CBC utilizes a code level earthquake, which approximates an earthquake with a 10% chance of exceedance in a 50-year period or an earthquake having a 475-year recurrence period.

The seismic design coefficient for the plywood shear wall buildings in the 2001 CBC is:

$$V = \frac{2.5C_a IW}{R} = \frac{2.5(0.44x1.38x1.15)W}{5.5} = 0.317W$$

The seismic design coefficient for the concrete shear wall buildings in the 2001 CBC is:

$$V = \frac{2.5C_a IW}{R} = \frac{2.5(0.44x1.38x1.15)W}{4.5} = 0.388W$$

The site seismicity is used to provide a benchmark basis for the visual identification of deficient elements in the lateral force resisting systems of campus buildings. The calculated base shear was used to perform a limited lateral analysis of the school buildings as described in section 10.7.

10.4 List of Documents

1. Crespi Middle School; Hardison, Clausen, Komatsu Architects; Pregnoff & Matheu Structural Engineers; sheets A-1 – A-2,A-4 – A-34, L-1 – L-2, S-1 – S-13, ME-1 – M-9, P-1 – P-7, ME-1 – E-9, K-1 – K-4; dated August 31, 1960, revised April 17, 1964; DSA application # illegible.
2. Crespi Middle School; Hardison and Komatsu Architects; Pregnoff & Matheu Structural Engineers; sheets A-1 – A-20, S-1 – S-10, P-1 – P-4, M-1 – M-4, E-1 – E-6; dated February 19, 1965, revised June 19, 1965; DSA application # 25607.
3. “Measure D” – WCCUSD Middle and High Schools – UBC revised parameters by Jensen- Van Lienden Associates, Inc., Berkeley, California.

10.5 Site Visit

DASSE visited the site on August 13th, 2002 and October 18th, 2002. The main purpose of the site visits was to evaluate the physical condition of the structure and in particular focus on the lateral force resisting elements of the building. Following items were evaluated during the site visit:

1. Type and Material of Construction
2. Type of Sheathing at Roof, Floor and Walls
3. Type of Finishes
4. Type of Roof
5. Covered Walkways
6. Presence of Clerestory Windows
7. Presence of Window Walls or High Windows in exterior and interior walls
8. Visible cracks in superstructure, slab on grade and foundation

Many of the buildings are single story structures that were built using traditional wood framed construction. The classroom buildings (Units 1, 2, 3, and 8), the library/administration building (Unit 4), and the mechanical building (Unit 7) all fall into this category. Although there is some variation, the interior of these buildings typically have acoustical tile ceilings, some of which are attached to the structure, while others are suspended. At some discrete locations, holes in the ceiling revealed a layer of drywall attached to the bottom of the structure. The interior walls are traditional plaster mixed with some wood wall paneling on the lower half of the walls. On the exterior, the buildings have a stucco finish and tall, relatively narrow windows that are repeated regularly throughout the classrooms. Although the roof framing is generally not exposed, longitudinal glue-laminated beams are seen at the roof eaves at the gable ends. Similarly, transverse wood beams are exposed at the other roof eaves. Although deterioration was not observed during these site visits, campus maintenance personnel indicated that these exposed beams have a history of water damage and repeated repair attempts. The typical classroom buildings are shown in figures 3, 4, 5, 6, 7, and 8.

Unit 1 serves as the shop building, and thus varies in some respects from the other classroom buildings. It is a taller structure that is built into the earth on one longitudinal side. The corridors step down into Unit 1, and the low ceiling in the hallway indicates that there is a mezzanine above. Conversely, the shop rooms and classrooms have high ceilings, where an interior cantilever glue-laminated beam was observed at one location. Additionally, an incinerator was observed on the south side of the building. This piece of equipment stands away from the building on stilt-type legs, but is tied into the structure.

Connecting these buildings is a system of covered walkways. These structures are framed with tongue and groove straight sheathing and exposed wood beams (in two directions), and are supported by circular concrete columns. It appears that the covered walkways linking the classroom buildings were open at one time, but have been enclosed with windows and doors since their original construction. In there current form they act like hallways between the various buildings. Surrounding Unit 7, there is an extensive amount of covered walkway area that remains open. In parts of this area, the framing is unsheathed consisting only of exposed wood beams. At some locations in this area, there appears to have been localized repairs made to some of the beam/column connections with steel plates and bolts. It was observed that the covered walkway structures connect multiple buildings, and that electrical conduits cross the interface of these structures. Because the conduit does not have the ability to stretch and thus to endure the potential differential displacements between the various buildings, a life safety hazard is identified.

The cafeteria/music building (Unit 5) is a single story concrete framed structure. In the cafeteria room, the exposed roof structure is composed of pre-cast double T-beams that span the transverse direction of the room. To form a diaphragm, the flanges of these double T-beams are connected with embedded steel reinforcement. The exterior concrete walls have only a few openings leaving what appear to be sufficient lengths of shear wall. While the ceiling in the cafeteria is open to the structure above, large wood framed panels with light fixtures hang from the concrete joists above. The interior wall finishes vary between plaster, acoustical tile panels, and wood paneling. Surrounding the front of Unit 5, is a wood framed canopy-type structure that is an extension of the covered walkway from the adjacent classroom building. The cafeteria/music building (Unit 5) is shown in figures 9, 10, 11, 12, and 13.

As the only multi-story building on the campus, the two-story gymnasium building (Unit 6) also utilizes a concrete structural system. From the first floor locker rooms the exposed gymnasium floor structure above is observed to be two-way concrete slab with drop panels supported by concrete columns. The exterior concrete walls at this level are nearly continuous with minimal penetrations. At the rear of the building, it appears that a portable structure has been erected between the two stairwells. The plywood walls and steel framed roof is indicative of a portable building that was most likely added sometime after the completion of the main structure. At the roof level, pre-cast concrete T-beams span the transverse length of the gymnasium. Where some of the ceiling panels are missing, metal deck framing was observed running perpendicular to the concrete beams, which are spaced at a much larger interval (approximately 20 feet) than is typical of this type of construction. Because the combination of these construction types is atypical, the existing roof diaphragm should be evaluated in detail in regard to its ability to support the concrete walls under out-of-plane loads (refer to section 10.6). As with the level below, the concrete walls at the gymnasium level are nearly solid with minimal openings; however, there is an out-of-plane offset between the shear walls at the two levels. This discontinuity results in the shear walls at the gymnasium level being supported on a system of columns and transfer beams, and requires the seismic shear forces to be transferred back through the first floor diaphragm. This type of configuration results in the application of large overturning forces to the supporting beam and column members. The potential brittle failure of these members, particularly the high axially loaded columns, is deemed a life safety hazard. The gymnasium building (Unit 6) is shown in figures 14, 15, 16, and 17.

10.6 Review of Existing Drawings

Unit 1 is a single story shop building. The wood framed roof structure is composed of 1/2” plywood sheathing and 2x4 members laid flat at 2’-0” centers. These intermediate members are supported by typical 3x12 joists spaced at 4'-0” centers, which span 17’-0” between three interior lines of wood beams (either glue-laminated or sawn lumber) and the exterior bearing walls. Wood posts support the wood beams. Lateral forces are resisted by shear walls sheathed with 1/2” plywood at the building perimeter and at some interior locations. There are window openings in the walls, but these are limited to reasonable areas that allow for sufficient shear wall strength. A positive “tie-down” connection is not provided between these shear walls and the foundation, as is needed at some critical locations to resist the expected seismic uplift forces. Collector forces are typically transferred to the shear walls through a double top plate at the top of the wall. However, in some locations this collector member is missing or lacks adequate strength in comparison to the expected seismic forces. The structure is founded on a system of strip footings (varying in thickness from 1’-2” to 2’-6”) and spread footings at the post locations. Lack of “tie-down” connections and inadequate collector strength in localized areas are deemed life safety hazards at Unit 1.

Although their dimesnions vary slightly, the Unit 2 and Unit 3 classroom buildings are structurally similar to Unit 1. Both of these single story, wood framed structures use 1/2” plywood over flat 2x4 members at 2’-0” centers, spanning between 3x12 joists spaced at 4’-0” centers. The spans of these roof joists are slightly longer than on Unit 1, but the system is consistant in that they are carried by a series of glue-laminated beams and bearing walls. Likewise, the exterior and some interior walls are sheathed with 1/2" plywood to resist lateral forces. The openings in these shear walls are minimal and thus the system has sufficient lateral strength. Collector forces are generally transferred to the shearwalls through a double top plate. At some locations, however, the framing lacks a collector element or its splice has insufficient strength in comparison to the expected seismic forces. A positive, "tie-down" connection between the shear walls and the foundation is not provided, and this connection is critical at a few locations to resist the expected seismic uplift forces. A spread footing foundation system was used on these buildings with a typical 1'-2" strip footing width. Localized life safety hazards are identified as inadequate collector strength and lack of "tie-down" anchors at Units 2 and 3.

Unit 4 houses the library and administrative offices and is another single story wood framed structure of the same construction type as Units 1, 2, and 3. The most significant difference between Unit 4 and the other structures is that its larger plan and different functions require some slight structural variations. The general roof framing system of 1/2"plywood sheathing, intermediate flat 2x4 members spaced at 2'-0" centers, roof joists spaced at 4'-0" centers, and glue-laminated beams is consistant with the other buildings. Due to longer spans, the roof joists at Unit 4 vary from 3x12 to 4x14. Again, plywood shear walls are used in significant proportions to resist lateral forces. Although more detailed analysis may later prove otherwise, this preliminary evaluation indicates that the structure needs an additional length of plywood shear wall in the longitudinal direction to resist the expected seismic forces. While the drawings do provide a positive, "tie-down" connection between the shear walls and the foundation at some locations, this detail does not occur at all critical locations. Although collector forces are generally intended to be transmitted through the double top plate at the top of the wood framed walls, a continuous collector with adequate splice strength is lacking at a number of locations. Along with various speard footings, typical 1'-2" wide strip footings support the post and bearing wall system. Life safety hazards identified at Unit 4 include inadequate shear wall strength, lack of "tie-down" connections, and inadequate collector strength.

Varying distinctly from the structural systems of the other buildings, the cafeteria/music building (Unit 5) was constructed using both pre-cast and cast-in-place concrete. The main roof structure is supported by pre-cast, prestressed concrete double T-beams across four spans ranging from 27'-9" to 40'-8". These 1'-2" deep double T-beams are spaced at 4'-0" on center and are spliced together to form a diaphragm by welding together reinforcement that was left exposed at the edge of each flange. Cast-in-place concrete bearing walls support the pre-cast beams at each end and are connected completely for the transfer of lateral forces by providing a closure pour between the walls and beam webs. The typical 8" walls have enlarged pilasters spaced at 7' to 8' on center, but the connection of these pilasters to the diaphragm lacks a strut and the adequate strength to resist the expected seismic force. These concrete walls have significant lengths to act as shear walls and provide resistance to lateral forces. Lateral forces are delivered to the walls through collector reinforceing in the top of the wall, which is adequate except for a couple localized deficiencies. In addition to the concrete framing, the front portion of the building has an extensive wood framed covered canopy/entrance structure. The combination of glue-laminated and sawn lumber beams at this location are supported by 1'-0" diameter concrete columns. These columns are supported on 4’-0” square spread footings, while the concrete bearing walls are founded on typical 2’-0” wide strip footings. The inadequate wall anchorage connections and localized inadequacies in collector strength constitute life safety hazards at Unit 5.

Also constructed of concrete, the gymnasium building, Unit 6, is the only two story building on campus. The roof framing over the gymnasium is a unique structural framing system that uses a metal deck in combination with pre-cast, prestressed concrete T-beams. A 4-1/2” deep metal deck is used to span between the 3’-0” deep T-beams with 8’-0” wide flanges that are spaced at 18’-8” centers. This metal deck diaphragm is welded to plates embedded in the pre-cast beams over the web and at the ends of the flange. The deck has inadequate strength as a diaphragm in comparison to the expected seismic forces. The beams are supported by concrete pilasters that are located between the tilt-up concrete wall panels at the gymnasium level. When subject to the expected out-of-plane loads, these tilt panels span horizontally between the pilasters; however at the transverse walls (21’ span) the 8” walls do not have adequate flexural strength. Additionally, the anchorage connection between the pilaster and the metal deck diaphragm lacks continuity ties at some locations and adequate strength at many locations. The gymnasium floor over the locker rooms, is framed with a 7-1/2” thick two-way concrete slab and 4” x 7’-9” square drop panels. The typical 1’-2” x 1’-2” concrete columns are located on a typical 18’-8” x 21’-0” grid system. At the perimter of the locker rooms, the gymnasium floor above is supported by cast-in-place concrete walls.

Lateral forces are resisted by concrete shear walls at both levels, which provide adequate shear strength to resist the prescribed forces; however, the connection of the tilt-up walls to the concrete floor diaphragm below lacks a positive connection for transferring these seismic shear forces. Additionally this system is vulnerable to seismic forces based on its configuration and detailing. Because there is an out-of-plane offset between the tilt-up walls at the gymnasium level and the cast-in-place walls at the locker rooms, the exterior columns below the higher walls will receive large axial overturning forces. While these columns are well detailed with spiral reinforcement at a 2” pitch, their potential failure would be non-ductile and could lead to a paartial building collapse. The foundation system is composed of typical 1’-8” wide strip footings and various sized spread footings at the column locations. The life safety hazards identified at Unit 6, the gymnasium building, include inadequate roof diaphragm strength, inadequate strength (out-of-plane) of the concrete walls, inadequate wall anchorage strength, lack of shear transfer connection between the wall and diaphragm, and vertical the discontinuity.

Unit 7, the mechanical building, is both the smallest and simplest structure on the campus. This single story wood building is framed with typical 2x8 and 3x8 joists spaced at 1’-4” centers spanning between wood bearing walls. The roof is sheathed with 1/2” plywood and includes a higher “clerestory” roof area. A couple of W10x21 steel beams are used in the framing of this raised, hip roof. Lateral forces are resisted by 1/2” plywood shear walls located at the building perimeter and some interior locations. Plywood sheathing on the clerestory walls also provides for the transfer of lateral forces from this higher level to the main roof diaphragm. Substantial lengths of solid shear wall provide sufficient strength for the resistance of lateral forces. At a couple of the interior shear walls the connection of the roof diaphragm to the wall lacks an adequate means of transferring the expected seismic shear forces. Collector forces are transferred by a combination of double top plates and headers, but the connections of these require strengthening to resist the prescribed seismic forces. Additionally these wall lengths lessen the need for a positive “tie-down” connection to the foundation, which has not been provided. Like a number of the other buildings previously discussed, the building is founded on strip footings that have a typical 1’-2” width. The insufficient shear transfer connection at the interior shear walls and the inadeqaute collector connections constitute life safety hazards at Unit 7.

The final classroom building, Unit 8, is the smallest of the classroom buildings, but is framed in the same manner. As described previously, the roof framing is composed of 1/2” plywood sheathing, flat 2x4 intermediate members at 2’-0” centers, 3x12 joists at 4’-0” centers, and glue-laminated beams. Wood bearing walls also provide for the support of gravity loads at the exterior of the building. These walls, in combination with some interior non-bearing walls are sheathed with 1/2” plywood to provide resistance to lateral forces. Because the lengths of solid shear wall are significant, collector forces are small enough to be compared favorably with the limited strength of the double top plate splice. In the longtiudinal direction, though, the double top plate splice has insufficient strength in comparison to the expected seismic chord force. Positive connections at the ends of the shear walls to the foundation are not provided, and are critical at some locations in comparison to the expected seismic uplift forces. Again this building rests on a strip footing foundation of a typical 1’-2” width. Unit 8 has life safety hazards in its lack of “tie-down” connections and inadequate chord strength at some critical locations.

With the exception of the gymnasium building, the entire campus is connected by a system of covered walkways. These are typically framed with 2x6 tongue and groove straight sheathing that is supported by 6x8 wood beams spaced at a maximum 7’-6” centers. Circular concrete columns (1’-0” diameter) are spaced a maximum 15’-0” centers are connected longitudinally by 6x10 wood beams. This system of covered walkways is connected multiple buildings without an allowance for the potential differential movement of the various buildings. Consequently, the potential of the structure to pull away from one or more of the buildings that provide support of gravity loads is inherent in the system and constitutes a life safety hazard.

10.7 Basis of Evaluation

The document FEMA 310, Federal Emergency Management Agency, *“Handbook for the Seismic Evaluation of Buildings – A Prestandard,”* 1998, is the basis of our qualitative seismic evaluation methods to identify the structural element deficiencies. The seismic performance levels included in FEMA 310 allow the engineer the choice to achieve the Life Safety Performance or the Immediate Occupancy Performance. We have based our evaluation of school buildings on the Life Safety Performance level for which is defined as “the building performance that includes significant damage to both structural and nonstructural components during a design earthquake, though at least some margin against either partial or total collapse remains. Injuries may occur, but the level of risk for life-threatening injury and entrapment is low.”

Because mitigation strategies for rehabilitating buildings found to be deficient are not included in FEMA 310 document, the California Building Code (CBC 2001) is used as the basis of our quantitative seismic evaluation methods and strategies for seismic strengthening of school buildings. The scope of our analyses were not to validate every member and detail, but to focus on those elements of the structures determined by FEMA 310 to be critical and which could pose life safety hazards. Element *strength* values not addressed in the California Building Code were based on the document FEMA 356, Federal Emergency Management Agency, *"A Prestandard and Commentary for the Seismic Rehabilitation of Buildings"* 2000.

10.8 List of Deficiencies

Building deficiencies listed below have corresponding recommendations identified and listed in Section 10.9, which follow the same order as the itemized list of deficiencies identified below. The severity of the deficiency is identified by a "structural deficiency hazard priority" system based on a scale between 1.0 and 3.9, which is described in Section 10.11. These priority ratings are listed in section 10.9. Priority ratings between 1.0 to 1.9 could be the causes for building collapses, partial building collapses, or life-safety hazards, if the corresponding buildings are subjected to major earthquake ground motions, which are possible at these sites. It is strongly recommended that these life safety hazards are mitigated by implementing the recommendations listed below.

Item	Building Structural Deficiencies
1.	Unit 1: Wood collector elements and/or connections lack adequate strength to resist the expected seismic forces at critical locations.
2.	Unit 1: Wood shear walls lack a positive connection to the foundation for the resistance of overturning forces at critical locations.
3.	Unit 2: Wood collector elements and/or connections lack adequate strength to resist the expected seismic forces at critical locations.
4.	Unit 2: Wood shear walls lack a positive connection to the foundation for the resistance of overturning forces at critical locations.
5.	Unit 3: Wood collector elements and/or connections lack adequate strength to resist the expected seismic forces at critical locations.
6.	Unit 3: Wood shear walls lack a positive connection to the foundation for the resistance of overturning forces at critical locations.
7.	Unit 4: Wood collector elements and/or connections lack adequate strength to resist the expected seismic forces at critical locations.
8.	Unit 4: Wood shear walls lack a positive connection to the foundation for the resistance of overturning forces at critical locations.
9.	Unit 4: Plywood sheathed walls lack adequate shear strength to resist the expected seismic forces.
10.	Unit 5: Chord/collector elements lack adequate strength to resist the expected seismic forces.
11.	Unit 5: Concrete wall anchorage connection lacks strength to transfer the expected out-of-plane seismic forces.
12.	Unit 6: Out-of-plane offset in concrete shear walls creates a vertical discontinuity in the primary lateral force resisting system.

Item	Building Structural Deficiencies
13.	Unit 6: Tilt-up concrete walls lack adequate load path for the transfer of seismic shear forces into the diaphragm or wall below.
14.	Unit 6: Metal deck diaphragm lacks adequate strength to resist the expected seismic forces.
15.	Unit 6: Concrete wall anchorage connection lacks strength to transfer the expected out-of-plane seismic forces.
16.	Unit 6: Concrete walls lack flexural strength to resist the expected out-of-plane seismic forces.
17	Unit 7: Wood collector elements and/or connections lack adequate strength to resist the expected seismic forces at critical locations.
18.	Unit 7: Diaphragm to shear wall connection lacks a complete load path or adequate strength to transfer the expected seismic forces.
19.	Unit 8: Wood chord elements and/or connections lack adequate strength to resist the expected seismic forces at critical locations.
20.	Unit 8: Wood shear walls lack a positive connection to the foundation for the resistance of overturning forces at critical locations.
21.	Campus: Covered walkway structures are connected to multiple buildings and lack the capacity to withstand differential building displacements.
22.	Campus: Hard conduits connect multiple structures and lack the capacity to withstand differential building displacements.

10.9 Recommendations

Items listed below follow the same order as the itemized list of deficiencies identified in section 10.8 above.

Item	Recommended Remediation	Priority	Drawing Number
1.	Provide new metal strapping, blocking, and/or collector beam at critical locations.	1.5	2
2.	Provide new hold-down anchors into foundation at critical shear wall locations.	1.5	1
3.	Provide new metal strapping, blocking, and/or collector beam at critical locations.	1.5	4
4.	Provide new hold-down anchors into foundation at critical shear wall locations.	1.5	3
5.	Provide new metal strapping, blocking, and/or collector beam at critical locations.	1.5	6
6.	Provide new hold-down anchors into foundation at critical shear wall locations.	1.5	5
7.	Provide new metal strapping, blocking, and/or collector beam at critical locations.	1.5	8
8.	Provide new hold-down anchors into foundation at critical	1.5	7

Item	Recommended Remediation	Priority	Drawing Number
	shear wall locations.		
9.	Provide new plywood sheathing at existing wood stud walls with new hold-down anchors into foundation.	1.3	7
10.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	9
11.	Strengthen concrete wall anchorage connection with new wall anchors and new diaphragm ties.	1.1	9
12.	Provide new concrete wall in-fill between existing columns at locations below the shear wall discontinuity. Provide new dowels into the existing concrete columns and wall above. Provide new concrete footings.	1.1	10
13.	Provide new continuous steel angle connection with dowels into the wall and floor slab.	1.0	11
14.	Provide new double angle members and connections with anchorage into lateral load resisting members to create a new horizontal diaphragm truss.	1.2	12
15.	Strengthen concrete wall anchorage connection with new wall anchors and new diaphragm ties.	1.1	12
16.	Provide new steel “strong backs” from the floor to roof diaphragm with anchors into existing concrete walls.	1.5	12
17	Provide new metal strapping, blocking, and/or collector beam at critical locations.	1.5	13
18.	Provide new metal connectors at inadequate connections.	1.5	13
19.	Provide new metal strapping, blocking, and/or collector beam at critical locations.	1.5	15
20.	Provide new hold-down anchors into foundation at critical shear wall locations.	1.5	14
21.	Provide new beam, columns, and footing to provide a secondary support of gravity loads at each connection of the covered walkway structure to an adjacent building.	1.9	2, 4, 6, 8, 9, 13, 15
22.	Provide new flexible conduit connections across seismic separation joints.	1.9	N.A.

10.10 Portable Units

In past earthquakes, the predominant damage displayed by portable buildings has been associated with the buildings moving off of their foundations and suffering damage as a result. The portables observed during our site visits tend to have the floor levels close to the ground, thus the damage resulting from buildings coming off of their foundation is expected to be minimal. The life safety risk of occupants would be posed from the potential of falling 3 feet to the existing grade levels during strong earthquake ground shaking. Falling hazards from tall cabinets or bookshelves could pose a greater life safety hazard than building movement. The foundation piers supporting the portable buildings tend to be short; thus the damage due to the supports punching up through the floor if the portable were to come off of its foundation is not expected to be excessive.

Because of their light frame wood construction and the fact that they were constructed to be transported, the portable classrooms are not in general expected to be life safety collapse hazards. In some cases the portables rest directly on the ground and though not anchored to the ground or a foundation system could only slide a small amount. In these instances the building could slide horizontally, but we do not expect excessive damage or life safety hazards posed by structural collapse of roofs.

The regulatory status of portables is not always clear given that portables constructed prior to 1982 will likely have not been reviewed by DSA and thus will likely not comply with the state regulations for school buildings. Portables constructed after about 1982 should have been permitted by DSA. The permits are either issued as temporary structures to be used for not more than 24 months or as permanent structures.

10.11 Structural Deficiency Prioritization

This report hazard rating system is based on a scale of 1.0 to 3.9 with 1.0 being the most severe and 3.9 being the least severe. Based on FEMA 310 requirements, building elements have been prioritized with a low rating of 1.0 to 1.9 if the elements of the building's seismic force resisting systems are woefully inadequate. Priority 1.0 to 1.9 elements could be the causes for building collapses, partial building collapses, or life-safety falling hazards if the buildings were subjected to major earthquake ground motion.

If elements of the building's seismic force resisting system seem to be inadequate based on visual observations, FEMA 310 requirements and limited lateral (seismic) calculations, but DASSE believes that these element deficiencies will not cause life-safety hazards, these building elements have been prioritized between a rating low of 2.0 to 3.9. These elements could experience and / or cause severe building damage if the buildings were subjected to major earthquake ground motion. The degree of structural damage experienced by buildings could cause them not to be fit for occupancy following a major seismic event or even not repairable.

The following criteria was used for establishing campus-phasing priority:

First, the individual element deficiencies which were identified during site visit and review of existing drawings were prioritized with a rating between 1.0 to 3.9 and as described in this section.

Next, based on the school district's budgetary constraints and scheduling requirements, each school campus was given a phasing number between one and three. Phase 1A represents a school campus with severe seismic deficiencies, Phase 1B represents a school campus with significant seismic deficiencies and Phase 2 represents a school campus with fewer seismic deficiencies.

10.12 Conclusions

1. Given the vintage of the building(s), some elements of the construction will not meet the provisions of the current building code. However, in our opinion, based on the qualitative and limited quantitative evaluations, the building(s) will not pose serious life safety hazards if the seismic deficiencies identified in section 10.8 are corrected in accordance with the recommendations presented in section 10.9.

2. Any proposed expansion and renovation of the buildings should include the recommended seismic strengthening presented in section 10.9. Expansion and renovation schemes that include removal of any portion of the lateral force resisting system will require additional seismic strengthening at those locations. It is reasonable to assume that where new construction connects to the existing building(s), local seismic strengthening work in addition to that described above will be required. All new construction should be supported on new footings.

3. Overall, we recommend that the seismic retrofit work on this campus be performed in Phase 2.

10.13 Limitations and Disclaimer

This report includes a qualitative (visual) evaluation and a limited quantitative seismic evaluation of each school building. Obvious gravity or seismic deficiencies that are identified visually during site visits or on available drawings are identified and documented in this report. Elements of the structure determined to be critical and which could pose life safety hazards are identified and documented during limited quantitative seismic evaluation of the buildings.

Users of this report must accept the fact that deficiencies may exist in the structure that were not observed in this limited evaluation. Our services have consisted of providing professional opinions, conclusions, and recommendations based on generally accepted structural engineering principles and practices.

DASSE's review of portable buildings has been limited to identifying clearly visible seismic deficiencies observed during our site visit and these have been documented in the report. Portable buildings pose several issues with regard to assessing their life safety hazards. First, drawings are often not available and when they are, it is not easy to associate specific drawings with specific portable buildings. Second, portable buildings are small one story wood or metal frame buildings and have demonstrated fairly safe performance in past earthquakes. Third, there is a likelihood that portable buildings (especially those constructed prior to 1982) are not in compliance with state regulations, either because they were not permitted or because the permit was for temporary occupancy and has expired.

Appendix A: Figures

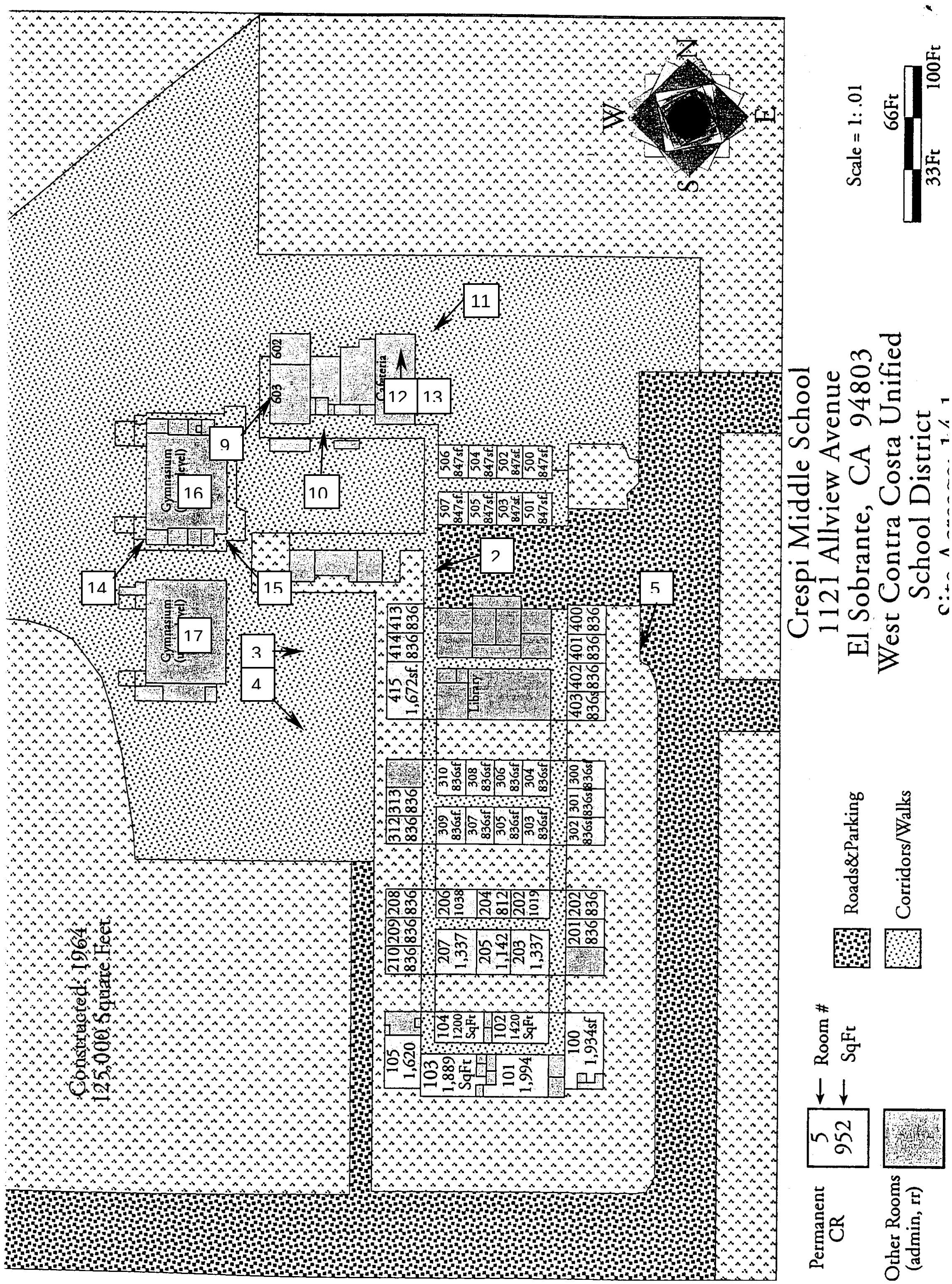


Figure 1: School Layout Plan

Figure 2: Campus Entrance

Figure 3: Library/administration Building (Unit 4), exterior west wall

Figure 4: Classroom Buildings (Units 1, 2, & 3), exterior west wall

Figure 5: Classroom Buildings (Units 1, 2, 3 & 4), exterior east wall

Figure 6: Typical Classroom Building (Unit 1, 2, 3, 4, 8), exterior longitudinal wall

Figure 7: Typical Classroom Building (Unit 1, 2, 3, 4, 8), exterior longitudinal wall

Figure 8: Typical Classroom Building (Unit 1, 2, 3, 4, 8), interior hallway

Figure 9: Cafeteria/music Building (Unit 5), exterior southwest corner

Figure 10: Cafeteria/music Building (Unit 5), exterior south covered walkway

Figure 11: Cafeteria/music Building (Unit 5), exterior northeast corner

Figure 12: Cafeteria/music Building (Unit 5), interior ceiling

Figure 13: Cafeteria/music Building (Unit 5), interior pre-cast joist flange splice

Figure 14: Gymnasium Building (Unit 6), exterior southwest corner

Figure 15: Gymnasium Building (Unit 6), exterior southeast corner

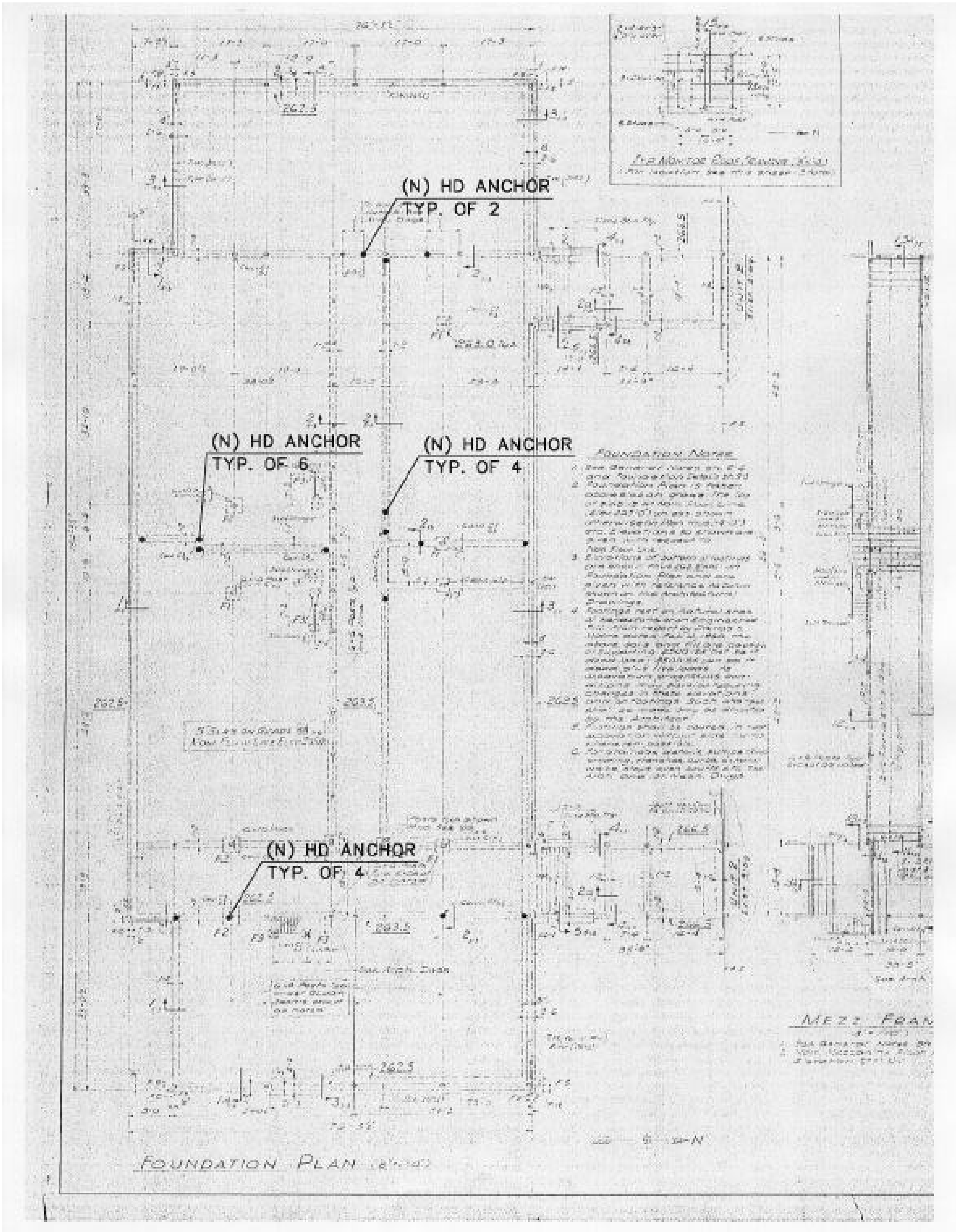
Figure 16: Gymnasium Building (Unit 6), interior locker room

Figure 17: Gymnasium Building (Unit 6), interior gymnasium

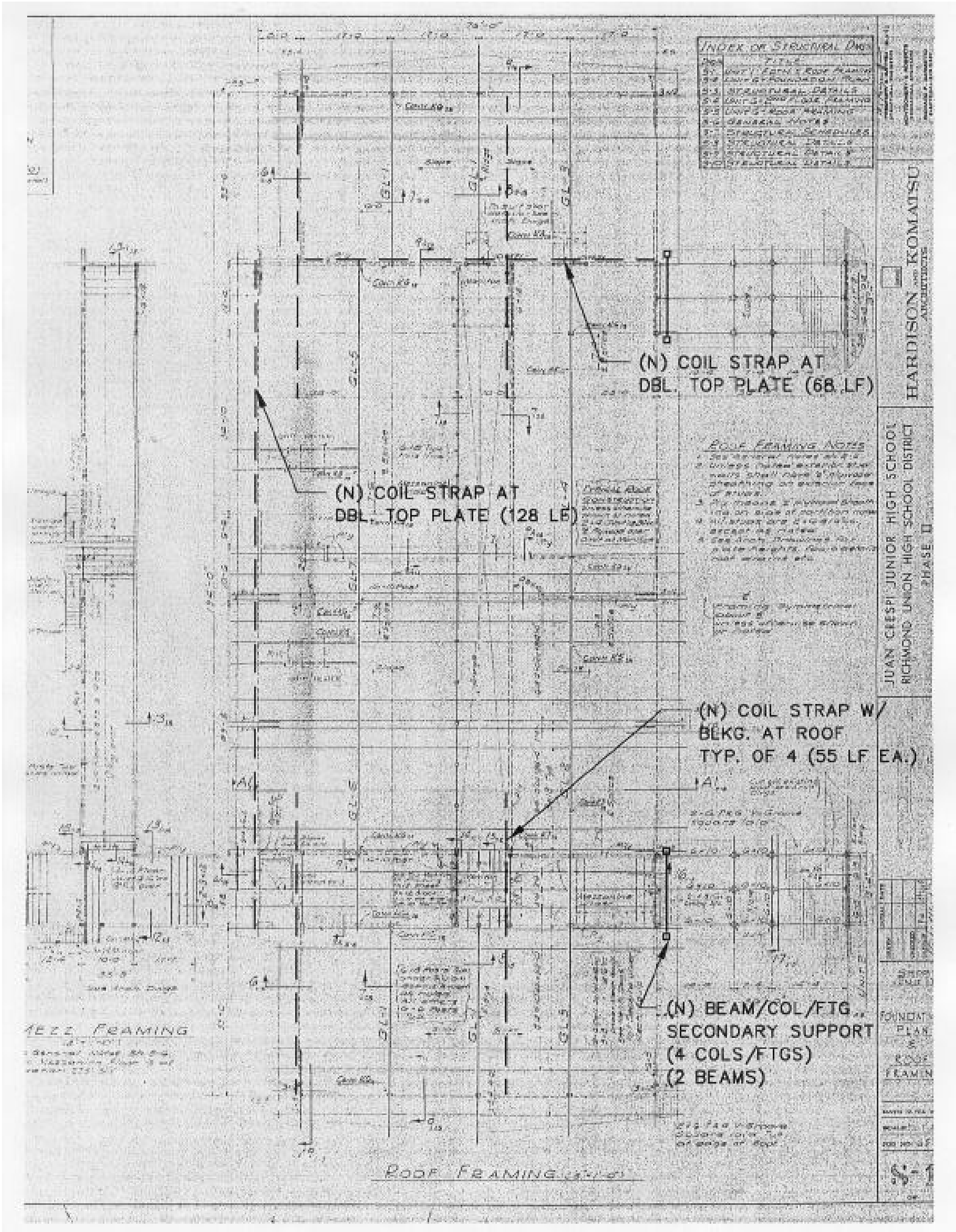
Figure 18: Covered Walkway, typical

Figure 19: Covered Walkway, hard conduit

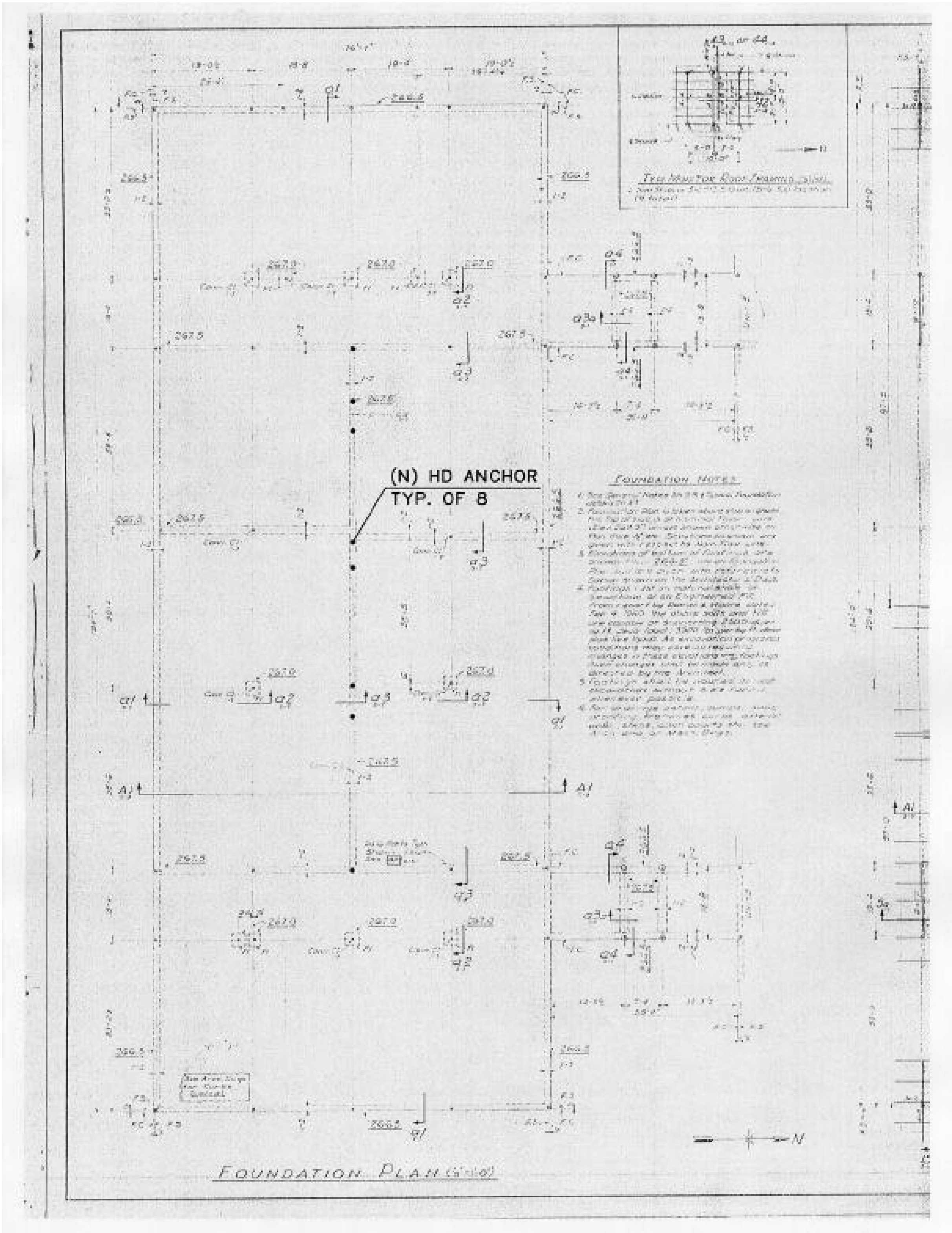
Appendix B: Drawings



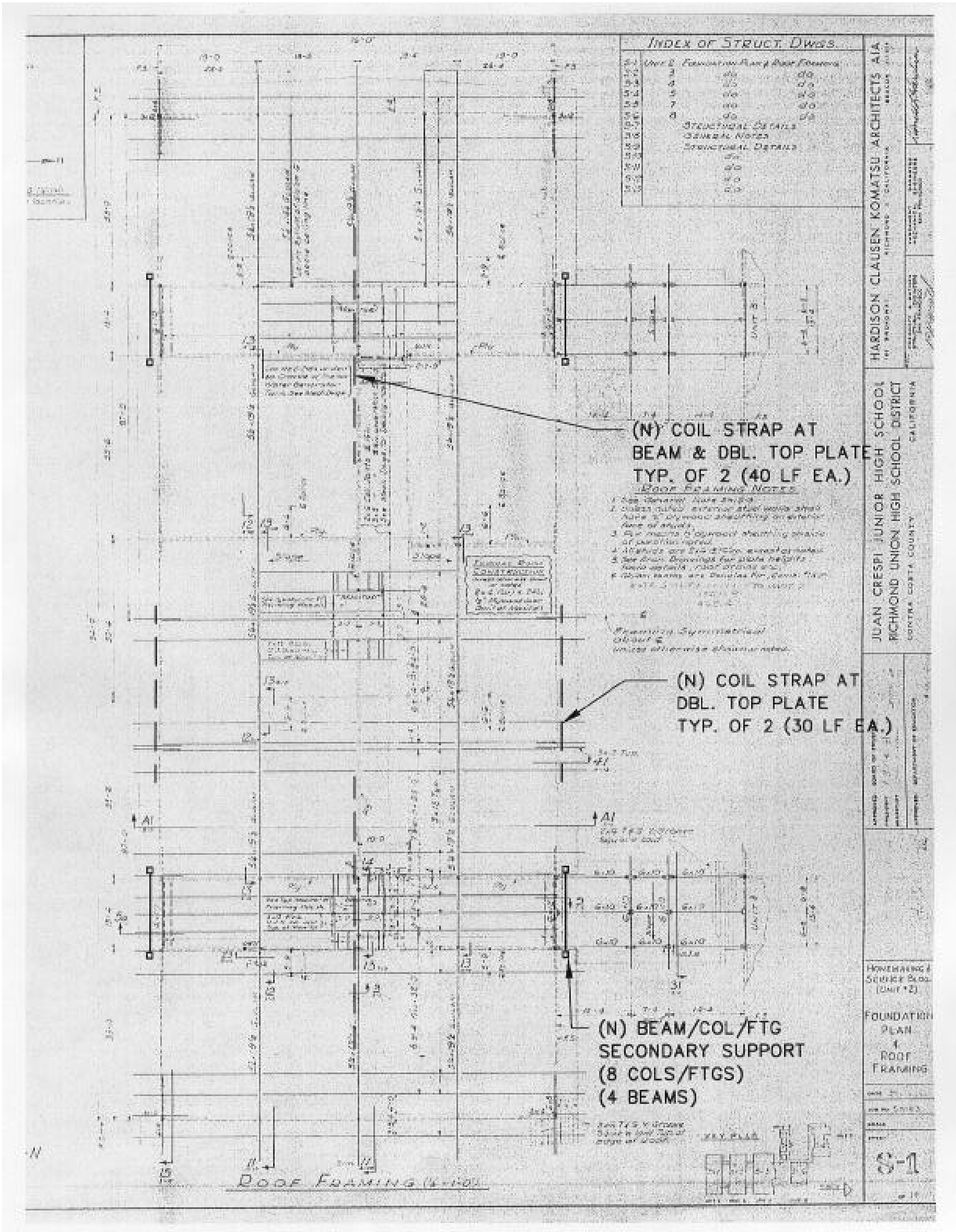
Drawing 1: Unit 1, Foundation Plan



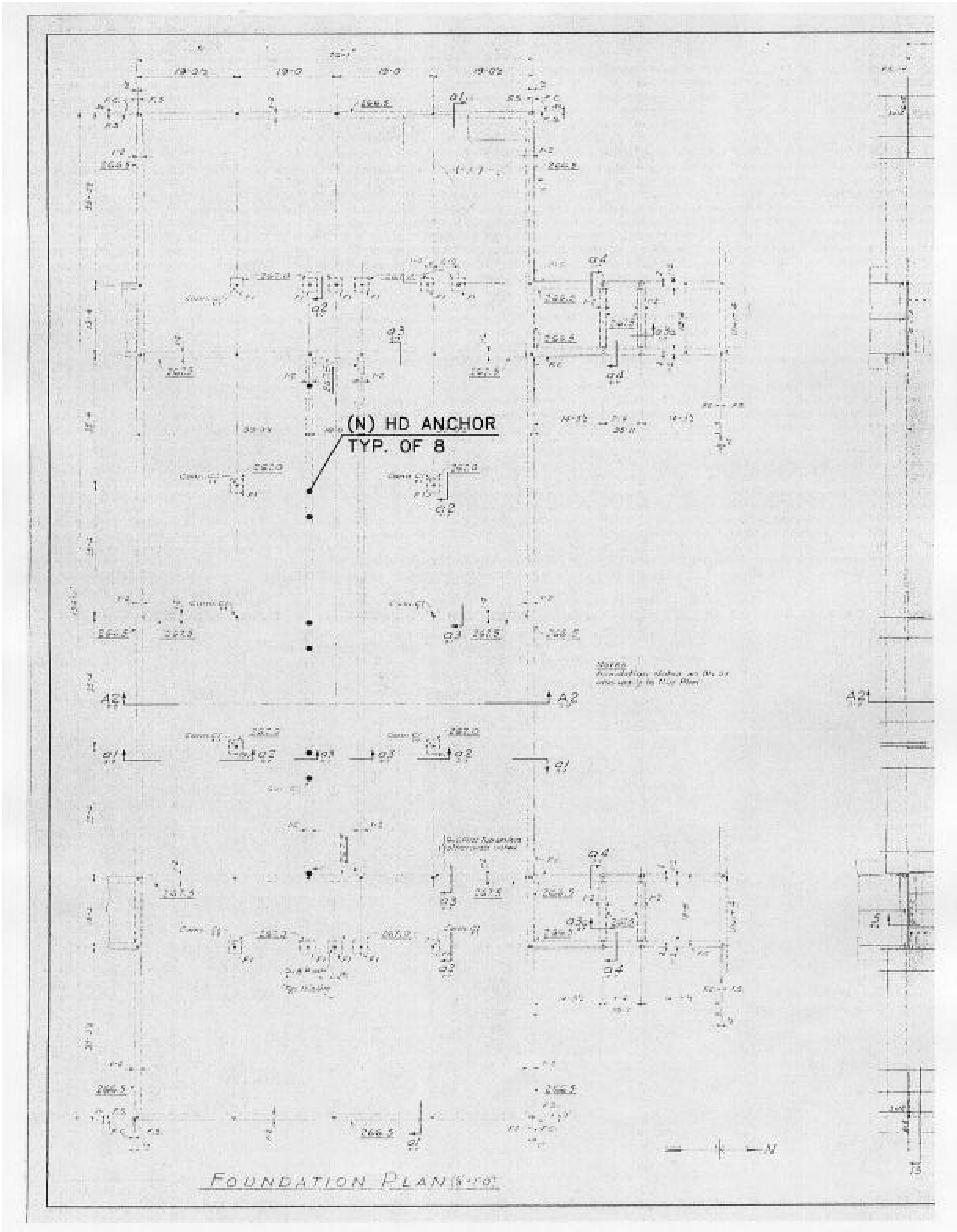
Drawing 2: Unit 1, Roof Framing Plan



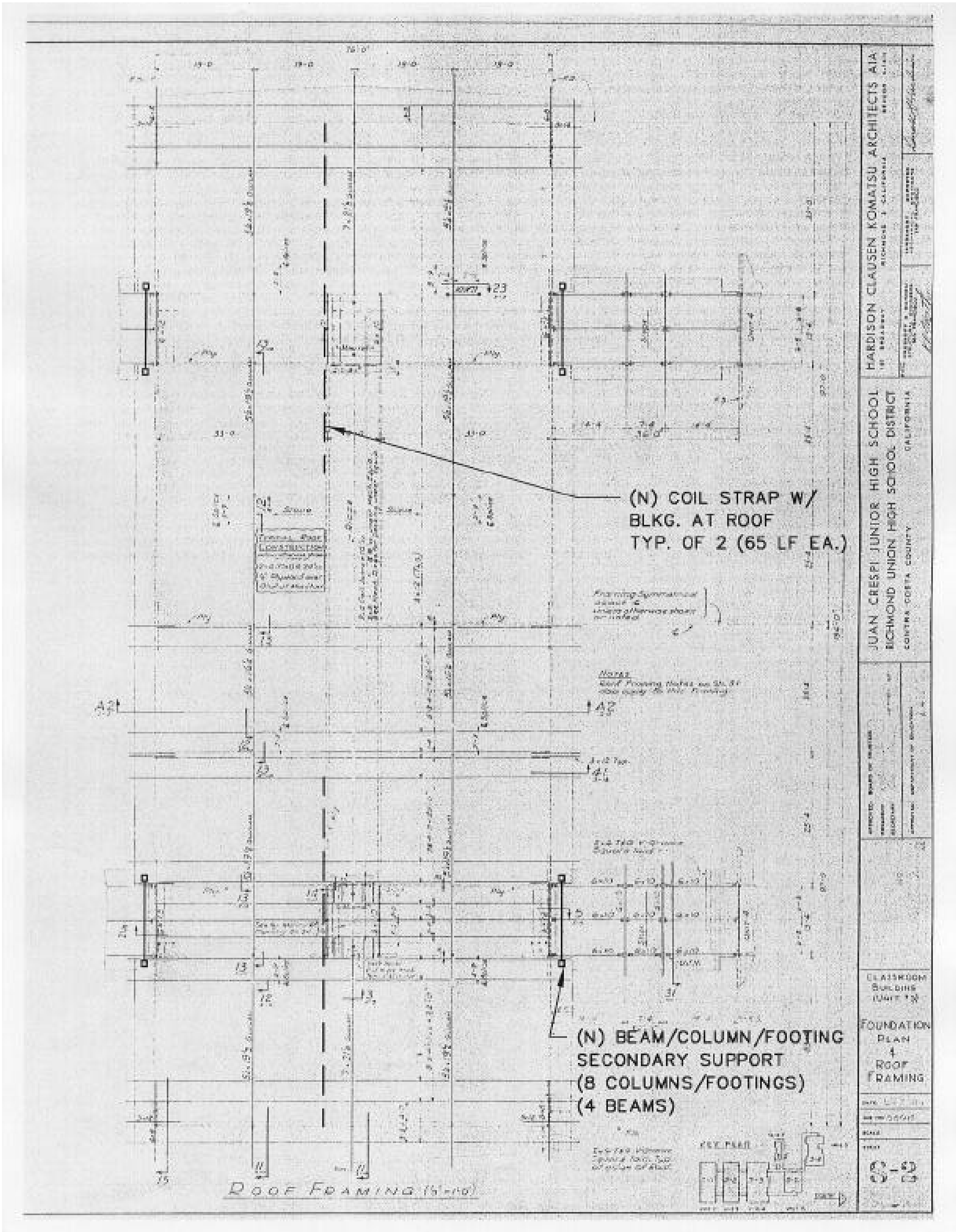
Drawing 3: Unit 2, Foundation Plan



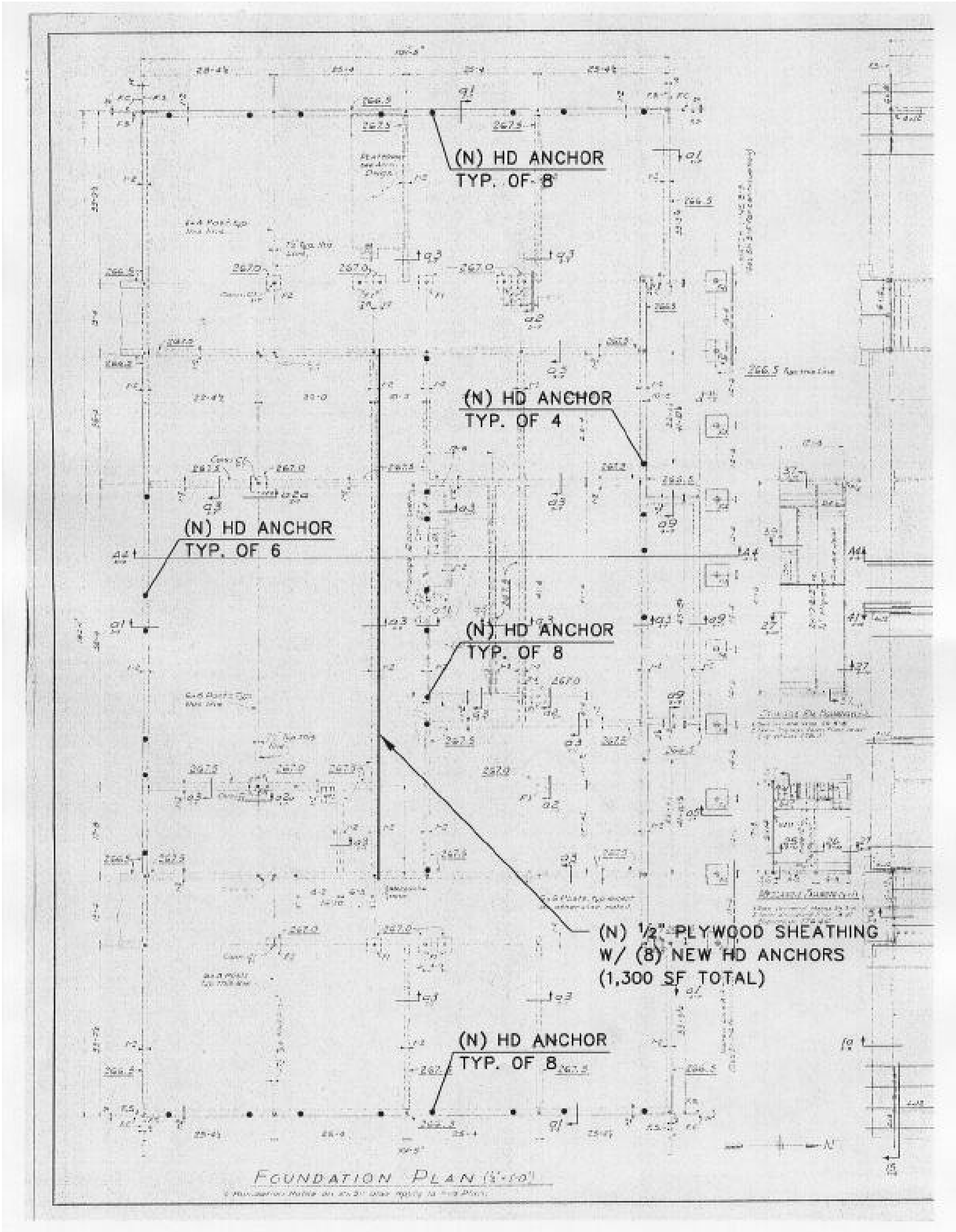
Drawing 4: Unit 2, Roof Framing Plan



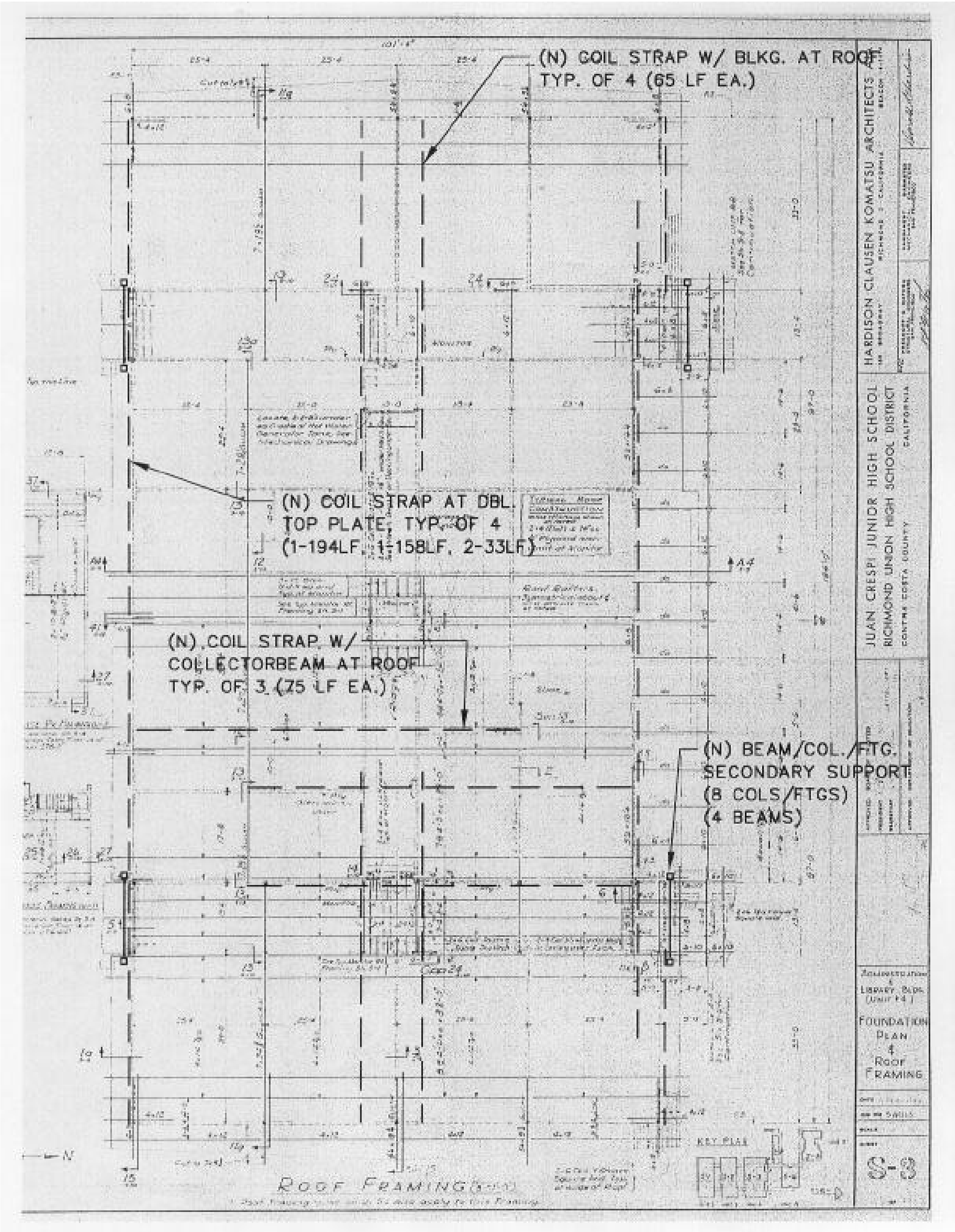
Drawing 5: Unit 3, Foundation Plan



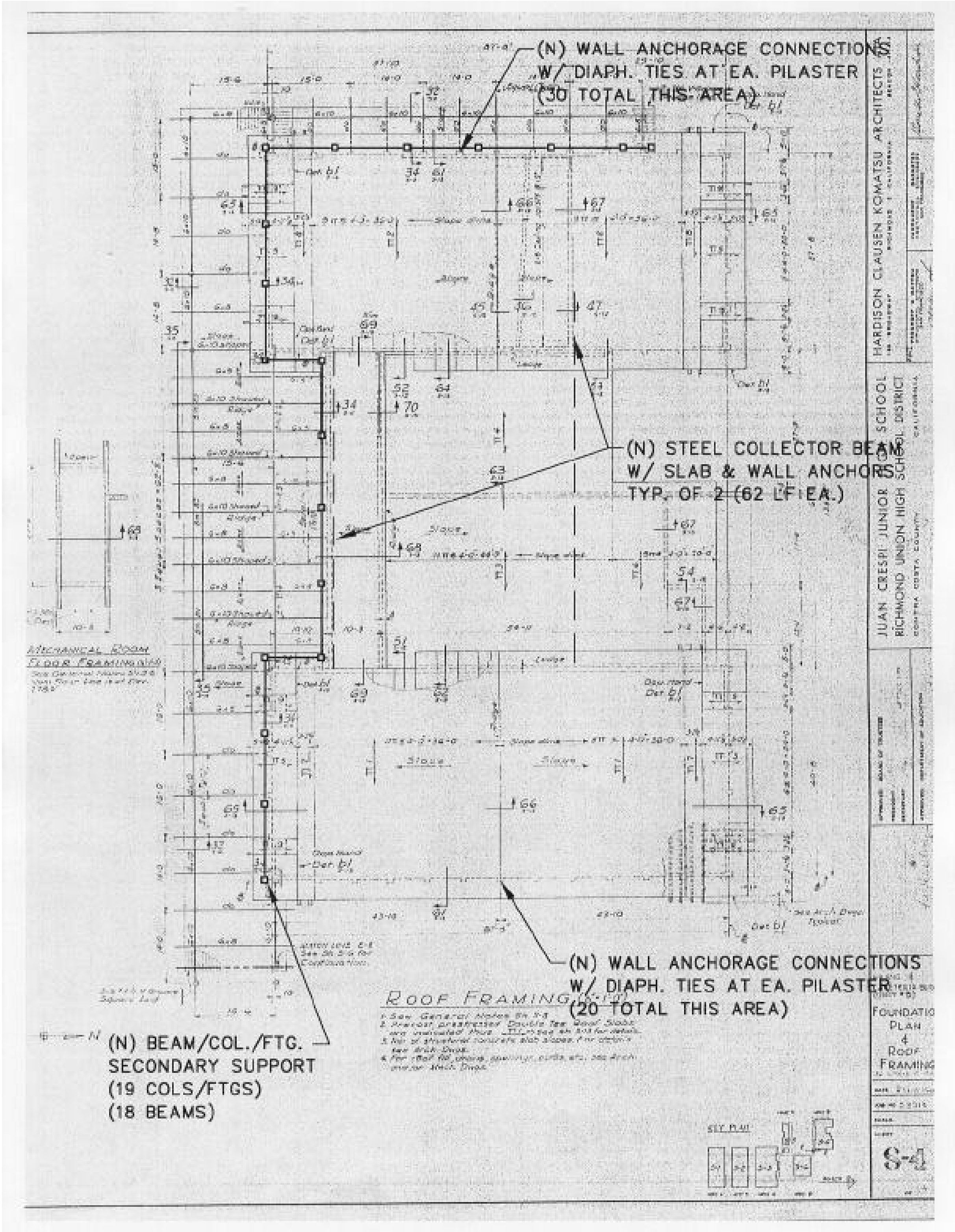
Drawing 6: Unit 3, Roof Framing Plan



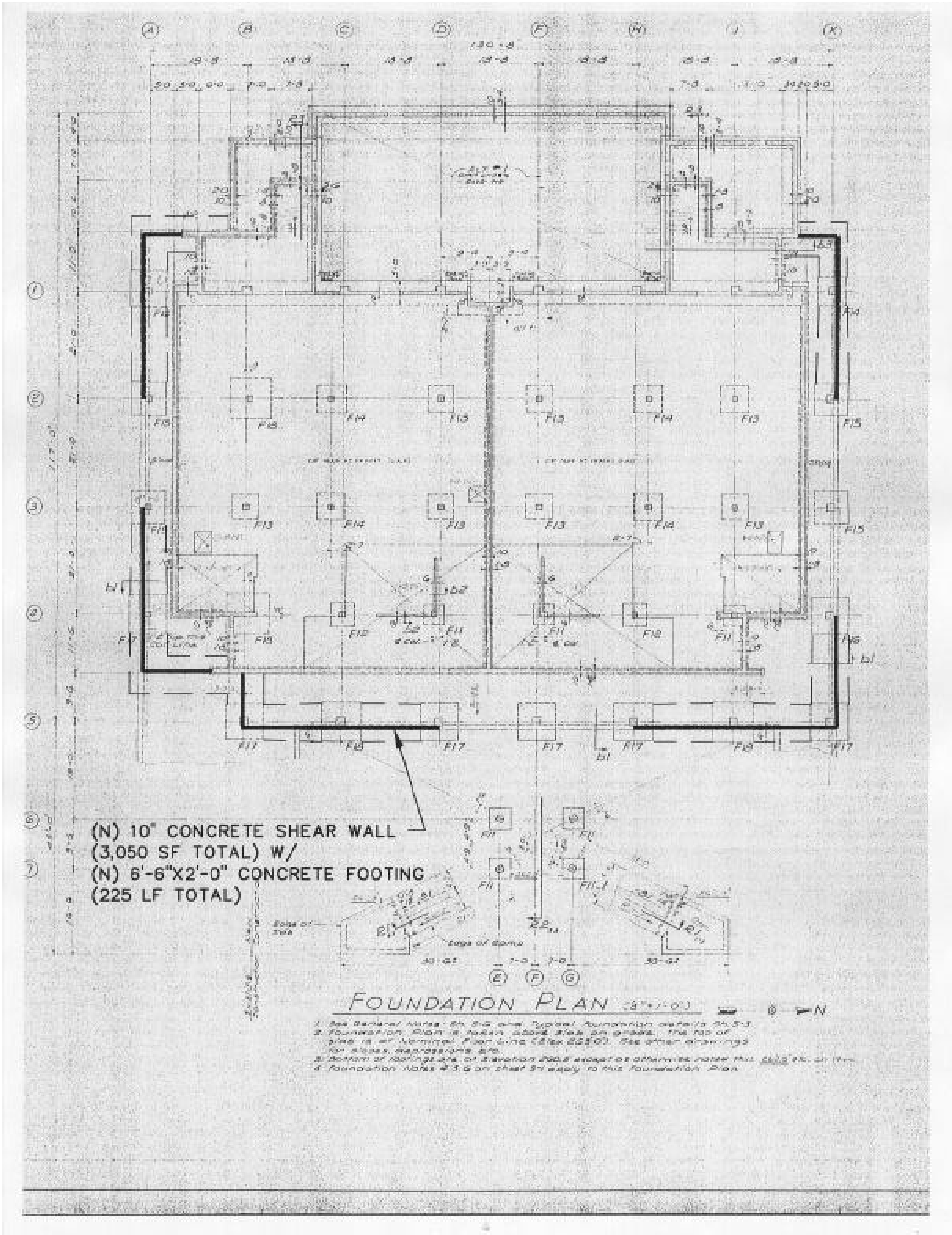
Drawing 7: Unit 4, Foundation Plan



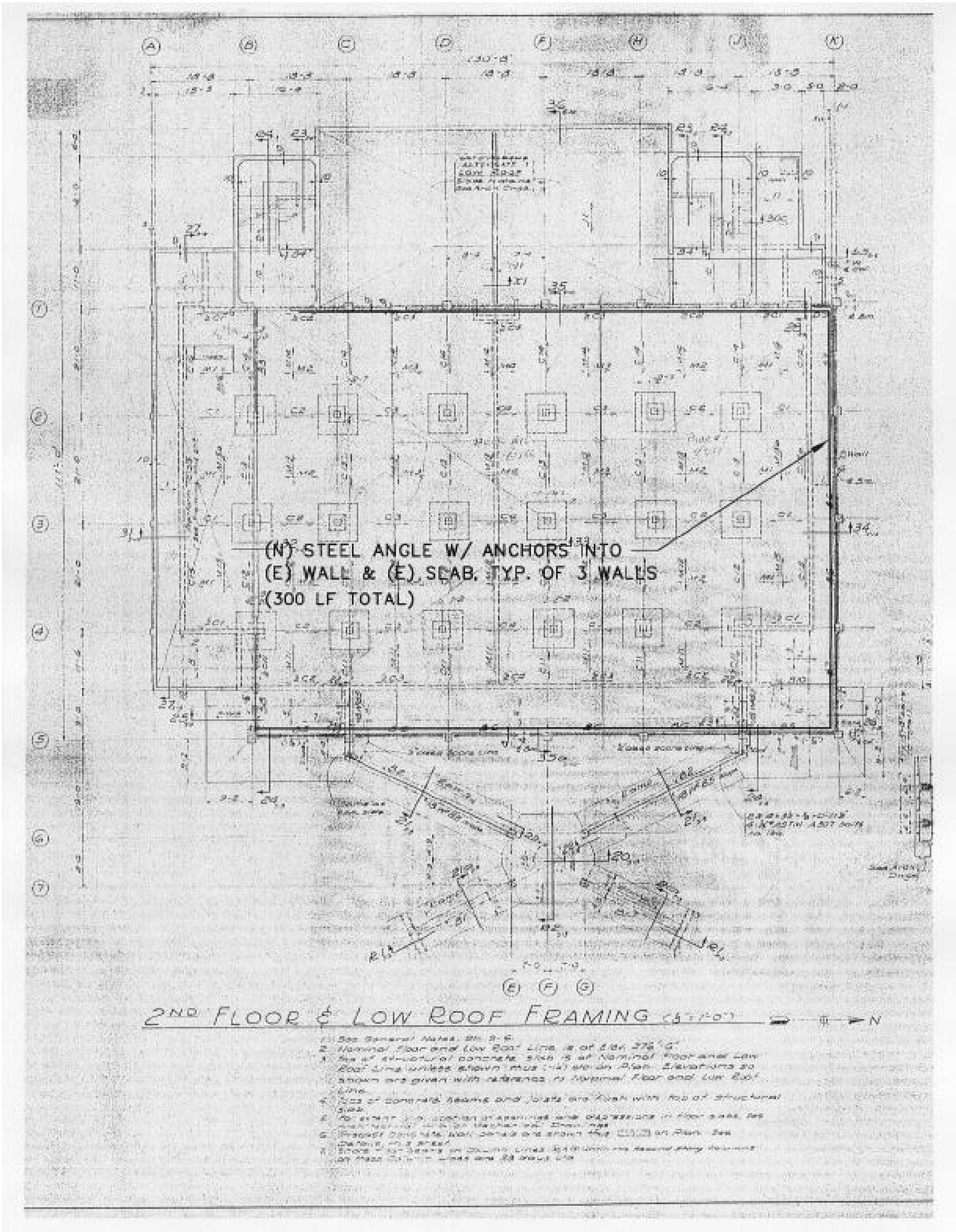
Drawing 8: Unit 4, Foundation Plan



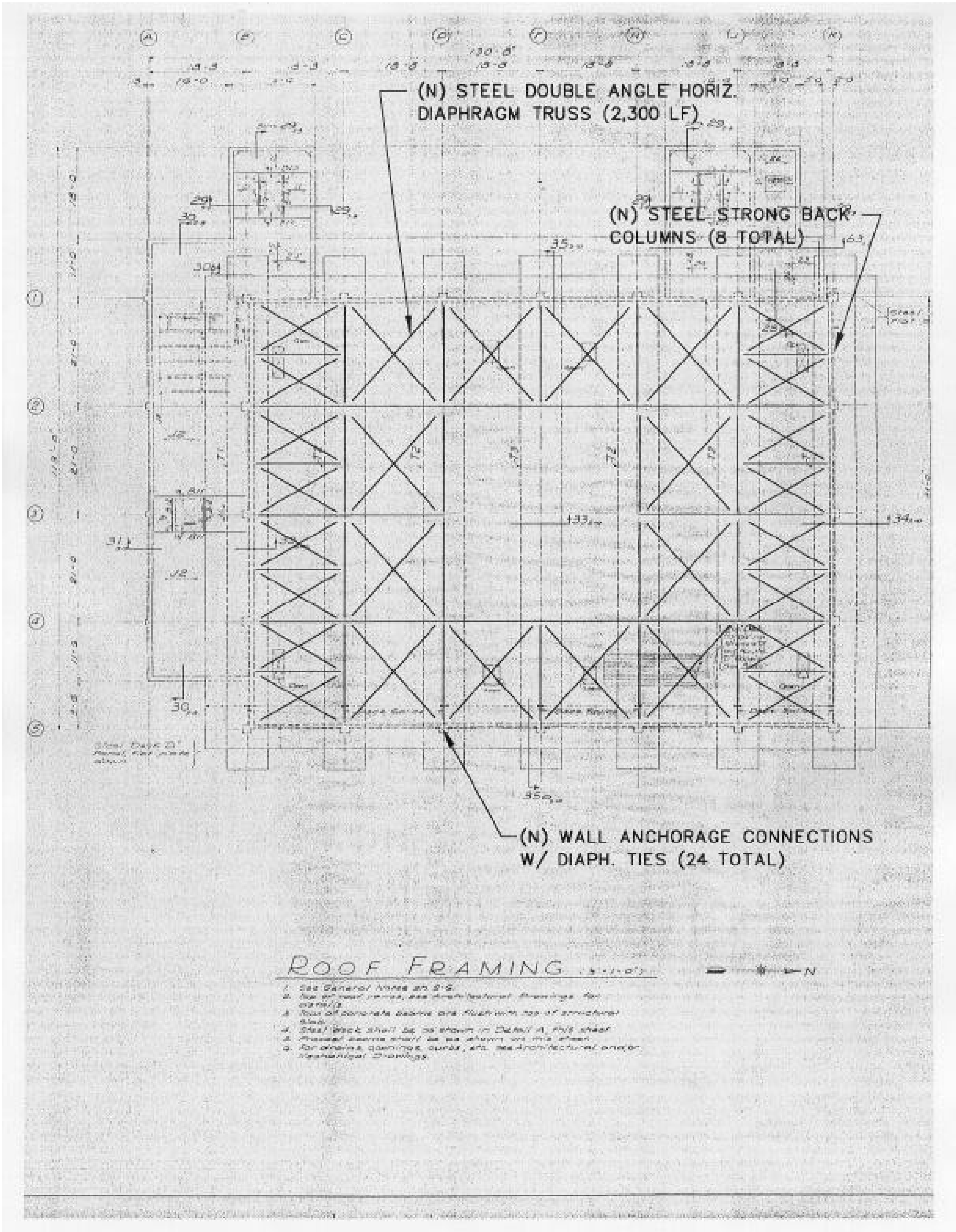
Drawing 9: Unit 5, Roof Framing Plan



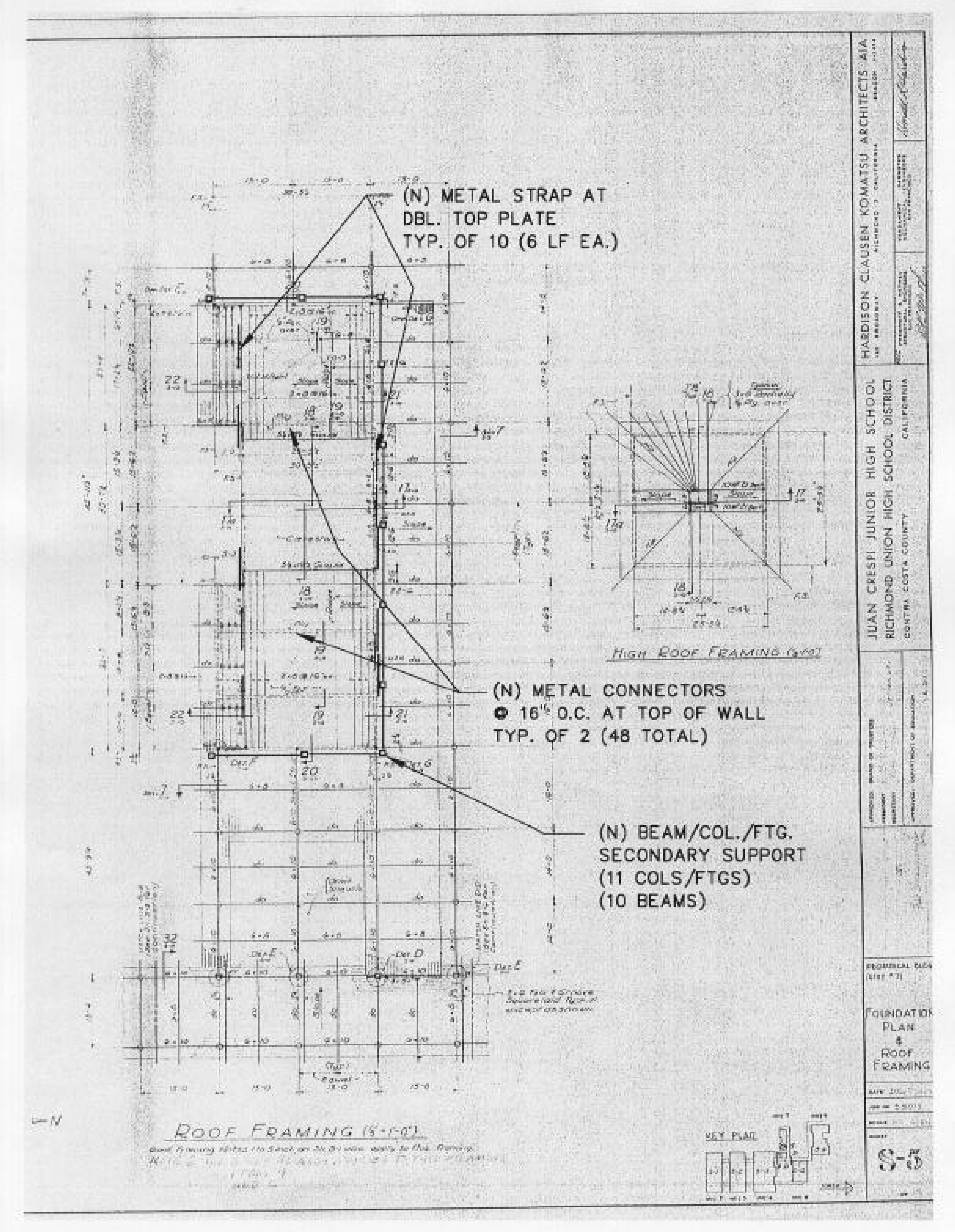
Drawing 10: Unit 6, Foundation Plan



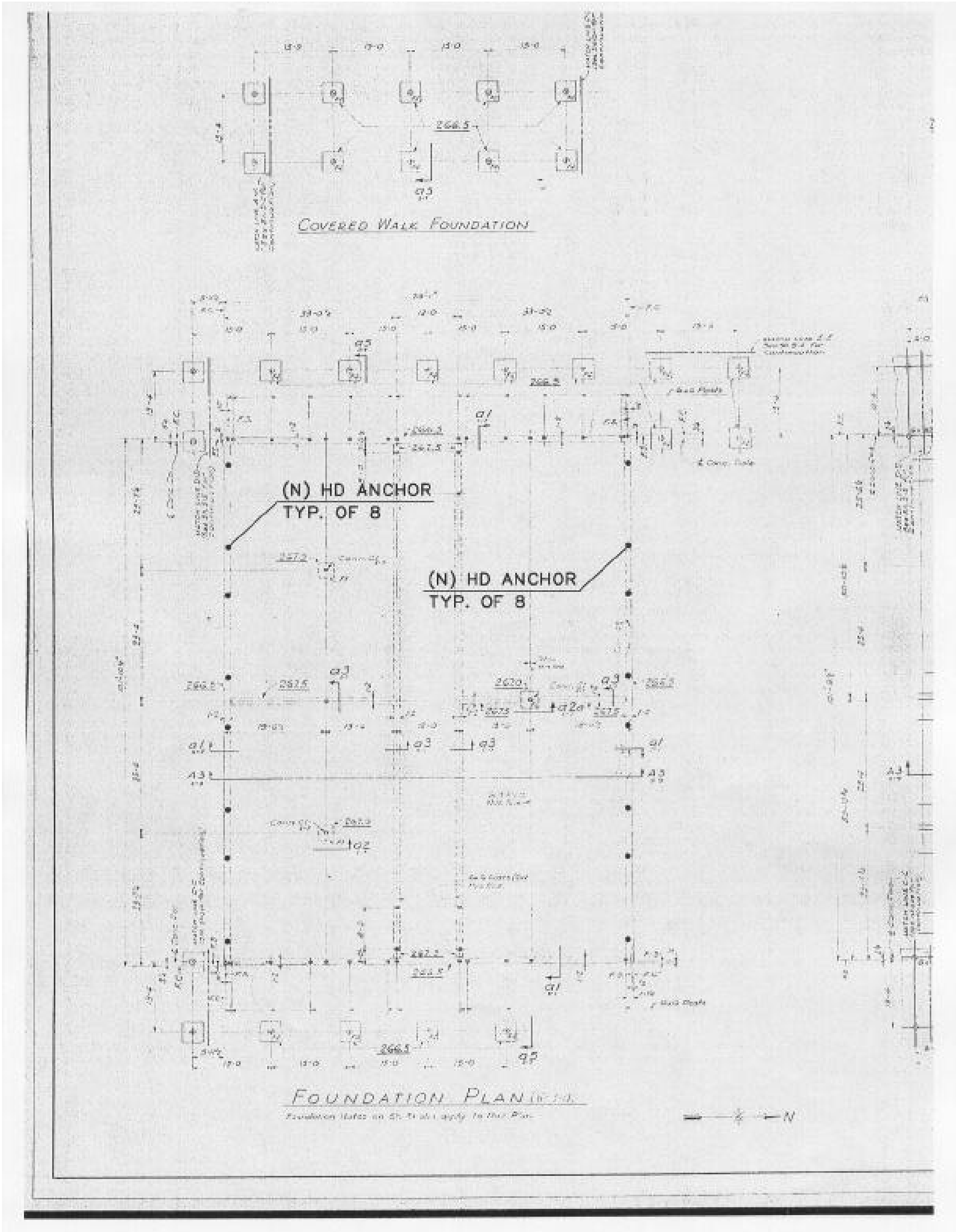
Drawing 11: Unit 6, Floor Framing Plan



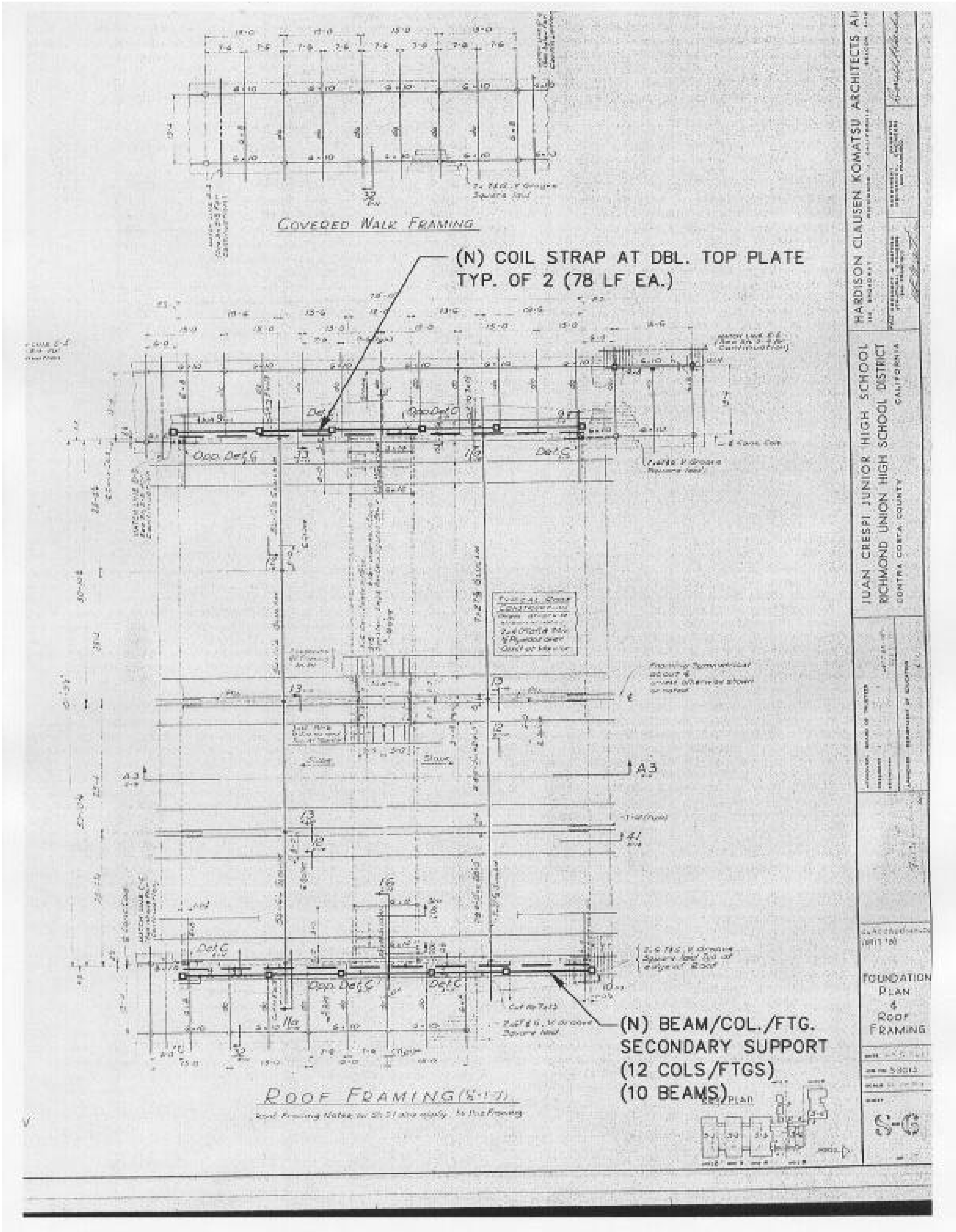
Drawing 12: Unit 6, Roof Framing Plan



Drawing 13: Unit 7, Roof Framing Plan



Drawing 14: Unit 8, Foundation Plan



Drawing 15: Unit 8, Roof Framing Plan