STRUCTURAL EVALUATION OF

HELMS 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 Helms Middle School in San Pablo, 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

Dating back to 1949, the largest and most predominant building on campus is the main classroom building. This concrete structure includes four, two-story classroom wings, a single story cafeteria wing, a single story administration wing, and a single story library wing. Along with the main building, two of the campus's other buildings were constructed at the same time. The gymnasium building is a single story structure of varying heights that was built out of a combination of concrete and steel construction. Also single story, the shop building is a concrete and wood framed building that was repaired in 1964 after it suffered fire damage. The final permanent building on the campus is the single story, wood framed music building, for which there is no documentation to determine the time of construction. In addition to these four permanent buildings, the campus has eight portable classroom buildings. Of these portable buildings two are from 1965, one is from 1986, two are from 1989, and the erection year of the remaining three is unknown at this time. Exclusive of these portable buildings, the total square footage of the permanent structures is 153,882.

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 main classroom building, shop building, and music building have an educational occupancy (Group E, Division 1), while the gymnasium building and cafeteria have an assembly occupancy (Group A, Division 2 and 2.1 respectively). Both of these occupancies have an importance factor in the 2001 CBC of 1.15. The campus is located at a distance less than 2 kilometers from the Hayward fault. The main classroom building is a concrete shear wall structure that includes non-ductile moment frames in the longitudinal direction of some wings. Non-ductile concrete moment frames are prohibited by the 2001 CBC in seismic zone 4. The concrete shear walls have a response modification factor of R = 4.5. The shop and gymnasium buildings also utilize a concrete shear wall system and have the same response modification factor of 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 in the 2001 CBC for a concrete shear wall system is:

$$V = \frac{2.5C_a IW}{R} = \frac{2.5(0.44x1.50x1.15)W}{4.5} = 0.422W$$

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. Helms Middle School; Classroom, Shop, & Gymnasium Buildings; Dragon, Schmidts, and Hardman Architects; sheets A-11 – A-48, S-1 – S-23, M-1 – M-8, P-1 – P-8, E-1 – E-7, L-1; December 28, 1949; DSA Application #7469.
2. Helms Middle School; Shop Building fire damage; Schmidts, Delaney & Associates; sheets A-37 – A-39, S-16 – S-17, M-5, E-6; September 24, 1964; DSA Application #25147.
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

The main building is a two-story structure at its four classroom wings and a single story structure elsewhere. This concrete framed building has numerous, continuous windows in the longitudinal direction at both the exterior and corridor walls. The typical classroom configuration has tall windows at the exterior wall and high windows over lockers at the corridor wall. At the second level, these high windows open to the outside over the lower corridor, while at the lower level the high windows open into the corridor. The classroom corridors have glass block windows at the lower level, and smaller window openings at the second level. At the corridors connecting the various rooms, large windows are found facing into the courtyards, while the outside walls tend to have more solid wall. The interiors typically have a suspended T-bar ceiling in the classrooms, and an acoustical tile ceiling in the corridors. No seismic joints were observed in the corridors, and hard conduits run the length of these corridors without compensation for the potential differential movement of the various building wings. This condition is considered a life safety hazard. The excessive lengths of windows found at the longitudinal walls of the classroom wings of the main building, indicate a severe deficiency in the strength of the structure to resists the expected lateral forces, and are also perceived to be life safety hazards. The classroom wings of the main building are shown in figures 3, 4, 5, 10, and 11.

Also part of the main building, the cafeteria wing is a single story with a covered walkway supported by steel pipe columns on the north side. The large cafeteria room has a plaster ceiling, and the walls have an interior plaster finish. An additional dining area to the east of the large room is also supported by steel pipe columns that have been infilled with windows, masonry, and concrete. At the time of the initial site observation, the re-roofing of the main building's roof was in progress. In the time between the two site visits, this roofing work was completed, new windows were installed at some locations in the cafeteria wing, and a large canopy structure was constructed to provide an additional outdoor eating area. The cafeteria wing of the main building is shown in figures 6, 7, 12, 13, and 25.

The remaining portion of the main building is comprised of the library wing, the administration wing, and various other rooms. The library wing is a larger structure, approximately 20' tall. The library has a plaster ceiling, and the adjacent hallway has a large skylight. Adjacent to the library, large wall height louvers occur in the exterior wall of the mechanical room. Overhead in the same area, a tall chimney extends above the roof level. Extensive window openings were observed at most of the exterior walls throughout the library wing, administration wing, and adjacent areas. While interior shear walls may exist in some of these areas, the excessive window openings indicate a deficiency in the strength of the structure to resist the expected lateral forces, and is consequently perceived to be a life safety hazard. The library wing, administration wing, and adjacent areas of the main building are shown in figures 2, 8, and 9.

A single story structure, the gymnasium building has a high roof (approximately 35' tall) at the gym area and a more typical roof height at the surrounding classroom areas. The high roof is framed with exposed steel trusses, and a large skylight is centered over the court. Around the main gym area, the longitudinal walls have numerous high, clerestory type windows. At the lower roof areas the framing consists of a concrete slab and beam system supported by concrete bearing walls. These shorter exterior walls also have many window openings. The limited strength of the concrete shear walls caused by the window openings at both the exterior and the gym area, appears to constitute a life safety hazard. The gymnasium building is shown below in figures 14, 15, 16, 17, and 18.

Located just south of the gymnasium is the shop building, another single story structure. This building has a rectangular plan shape and is 18’ to 20’ tall. The longitudinal walls have nearly continuous windows that are located in a band over the doorways. Inside the building, pairs of skylights are observed straddling the longitudinal centerline of the building. Light fixtures are hung from the high ceiling above. Near the east end of the building, a mezzanine was observed. The mezzanine space has hard wood floors, and appears to be used predominately for storage. The continuous window openings at the longitudinal walls, inhibit the shear wall strength to the point that a life safety hazard is perceived. The shop building is shown below in figures 19, 20, and 21.

At the very rear of the campus the music building is a single story, single room building. This structure has a wood framed system, as interior wood posts and beams were observed running the longitudinal length of the building. This framing appears to have been modified at some point after the original construction by sandwiching the wood beam with two steel channels in order to remove the center post and create a longer beam span. The exterior of this rectangular building has a plaster finish with an appearance that matches the adjacent shop building. The exterior walls are nearly completely solid with only the most minimal window openings. At the west end of the structure some partial height practice rooms are framed out of wood and covered on the interior walls and ceiling with acoustical tile. The greater interior of the building has a hard ceiling and wood wall paneling up to a 7’ height and acoustical tile above. The music building is shown in figures 22, and 23.

Of the portable structures, two are located closely together between the main building and gymnasium building, while the other six are located opposite the playground area. The former appear older than the others and are in a poorer condition (some rusting was observed in the awnings). At the newer portable buildings, some hard conduit was observed running between separate structures. The inability of these conduits to withstand the differential displacement of the separate structures is recognized as a life safety hazard. The older portable buildings are shown in figure 24.

10.6 Review of Existing Drawings

The largest portion of the campus is housed in the main building. This building is composed of multiple wings that serve various functions, but from a structural viewpoint all of these components are connected to form one structure. The five main wings are connected at either end by corridors framed with one-way concrete slabs and concrete walls. Because the main wings may move in conflicting directions, the potential exists for the corridor slab to tear away from one or both of the wings that provides its lateral support. The inability of this system to withstand these differential lateral displacements represents a life safety hazard.

The four wings of the main building used for classrooms are two stories in height and are nearly identical. Above the first floor slab on grade, these wings are framed at the roof and second floor levels with 12-5/8” and 16-5/8” deep concrete pan joist that span the transverse width of the classrooms. The corridor on the south side of each wing is framed with a 4-3/4” thick one-way concrete slab. The pan joists are supported by three lines of concrete beams (varying from 9”x1’-2” to 1’-3”x1’-8”) and columns (varying from 9”x1’-7” to 10”x1’-8” to 1’-0”x1’-8”) that run the longitudinal length of each wing at the north wall and between the classrooms and corridor. A third beam/column line with similar sections runs along the south side to support the remainder of the corridor framing. The combination of concrete slabs at both levels provides a rigid diaphragm. At some upper level locations, the columns of the south wall are actually wider wall piers; however, like the other two concrete frames, the strength of these lines is limited by the concrete columns below. Although they are not well reinforced for this purpose, it appears that the concrete frames were intended to resist lateral forces in the longitudinal direction as moment frames. These concrete moment frames are very flexible and have deficient reinforcement details that are likely to cause a brittle, non-ductile behavior during a large seismic event. In the transverse direction, lateral forces are resisted by concrete shear walls at each end and at one intermediate location. Collector forces are transferred by horizontal beam reinforcing; however, the splices of these bars limit their strength to transfer the expected seismic forces. The structure is founded on spread footings at the columns and a 1’-8” wide strip footing at the north wall. The inadequate strength and ductility of the concrete moment frames and the inadequate strength of the collector reinforcement represent severe life safety hazards in the classroom wings.

The fifth wing of the main building is a single story structure that is occupied by the cafeteria and multipurpose rooms. The cafeteria portion of the building uses steel roof framing and 2-1/2” thick gypsum concrete roof. The 50’ wide main room is spanned by four steel trusses built of double angle sections and spaced at approximately 20’ centers. Between the main trusses a system of purlins (spaced at 5’-1” on center) and subpurlins (spaced at 2’-8-5/8” on center) provides the remainder of the roof framing. The gypsum concrete is poured over 1/2” sheetrock. Due to the nature of the gypsum concrete material, the structural value of this roof system as a diaphragm is negligible, which has been accounted for by providing a horizontal diaphragm truss constructed of steel tension rods at the bottom chord of the main roof trusses. In general this is considered a poor system under cyclic loading, but even under static loading the tensions rods have inadequate strength to resist the expected diaphragm forces. The roof framing is supported by concrete bearing walls. Both the walls and their anchorage connections to the roof are inadequate in comparison to the out of plane seismic forces. These walls also serve as shear walls to resist lateral forces. Due to substantial window openings at the longitudinal walls, this system lacks adequate strength to resist the expected forces. As was done elsewhere, horizontal reinforcement in the top of the walls is provided for the transfer of collector forces, and as was found elsewhere these bars and their splices lack the strength required. A combination of spread and strip footings supports the structure at the foundation. Life safety hazards identified at the cafeteria wing of the main building include inadequate concrete walls (out-of-plane) and anchorage connections, inadequate shear wall strength, inadequate diaphragm truss strength, and inadequate collector strength.

Among the other one story portions of the main building, the administration wing, study hall room area, utility area, and additional dining area are all framed with a concrete pan joist roof system. The pan joists, which vary in depth from 12-5/8” to 16-5/8”, are typically supported by concrete bearing walls, with the exception of the additional dining area, which uses concrete beams and steel pipe columns to support the joists. As in the classroom wings, the 2-5/8” thick continuous concrete slab provides a rigid roof diaphragm. Lateral forces are resisted by concrete shear walls that are adequate in most locations with the exception of the additional dining area.

The transfer of collector forces is intended to be transmitted through horizontal reinforcement in beams and at the top of walls; however, the strength of these are insufficient due to the bar splices and the long distances to the shear walls. These portions of the main building are founded on a combination of strip and spread footings of various sizes. The absence of shear walls at the additional dining area and the inadequate strength of the longitudinal collectors constitute life safety hazards in this area of the main building.

The final portion of the main building is the single story library wing. Like the cafeteria, the library wing is distinguished by its use of steel roof framing and 2-1/2" thick gypsum concrete roof. At the roof, 1'-6" deep steel joists are spaced at 3'-0" centers and span the 32'-6" transverse width of the main room. Again like the cafeteria, subpurlins spaced at 2'-8-5/8" centers complete the room framing and the gypsum concrete is poured over 1/2" sheetrock. Although the structural value of this gypsum roof system as a diaphragm is negligible, no other diaphragm systems is provided. Thus the structure is lacking a credible system for transferring lateral loads at the roof level. The concrete bearing walls that support the roof framing have both inadequate flexural strength and inadequate anchorage connections to the roof when the expected out of plane forces are considered. These walls also serve as shear walls to resist lateral forces, but given the substantial window openings at the longitudinal walls, this system lacks adequate strength to resist the anticipated seismic forces. Again, the horizontal reinforcement used to transfer the collector forces is found to be insufficient. A combination of spread and strip footings supports the structures at the foundation. Life safety hazards identified at the library wing include inadequate concrete walls (out-of-plane) and anchorage connections, inadequate shear wall strength, inadequate collector strength, and lack of a roof diaphragm.

Designed along with the main building, the gymnasium building employs many of the same framing techniques previously discussed. The building is composed of the main gym area with a high roof, and the surrounding ancillary areas that have a lower roof. The lower roof is framed with concrete pan joists with a typical total depth of 8-1/2" including a 2-1/2" thick continuous slab. The joists span between steel wide flange beams (typically W21x62 and W24x76) that are encased in concrete and spaced at an average of 16'-6" on center. The steel beams are supported by concrete bearing walls. At the high roof, the framing is quite similar to the cafeteria room of the main building. Six large steel roof trusses span the 86'-6" width of the gymnasium, while a system of purlins (spaced at 7'-3" on center) and subpurlins (spaced at 2'-9" on center) fill in the remainder of the framing. Similar to the cafeteria, the roof itself is composed of 2-1/2" thick gypsum concrete fill set over a 1" sonotherm product. The inadequacy of this roof system as a diaphragm as previously discussed, is accounted for by a horizontal diaphragm truss composed of steel angles located at the bottom chord of the main roof trusses. However, the diaphragm truss lacks adequate strength. As with the lower roof, the high roof framing is supported by concrete bearing walls. The anchorage connection of these walls at the high roof level is inadequate to resist the out of plane wall forces, and at some locations the flexural strength of these walls is also insufficient. These concrete shear walls provide the lateral force resisting system in the structure. Due to an extensive amount of window openings at the exterior walls both at the lower and upper locations, these walls lack adequate strength in comparison to the expected seismic forces. As seen elsewhere, the horizontal reinforcing intended to transfer seismic forces is inadequate when compared to the expected forces. Strip footings of various widths provide foundation support. At the gymnasium building life safety hazards are identified in the inadequate concrete walls (out-of-plane) and anchorage connections at the high roof, the inadequate strength of the high roof diaphragm truss, the inadequate collector strength, and the inadequate shear wall strength.

The shop building is distinguished on this campus by its use of wood framing. This single story structure has a sloped roof in the transverse direction framed with 2x10 rafters at 2’-0” on center. The rafters span approximately 15’-9” between the exterior bearing walls and three interior lines of steel wide flange beams (typically W12x27 and W14x30), which are supported by 6x10 wood posts. The roof is sheathed with 1” diagonal sheathing. The exterior perimeter walls of the building are concrete and serve as both bearing and shear walls. At the roof diaphragm, the anchorage of these concrete walls is inadequate. The interior of the building includes three separate wood framed mezzanine levels. While the roof level varies from 16’-1’ to 21’-4”, the mezzanines are located at 9’-0” off the main floor. They are framed with 3x12 and 2x8 joists spaced at 1’-4” centers. Lateral forces are resisted by a combination of the exterior concrete shear walls and some interior, plywood sheathed shear walls in the transverse direction. In the longitudinal direction, the exterior walls are disrupted by so many window openings, the remaining length of shear wall has inadequate strength. Additionally, the plywood shear walls lack adequate strength to resist the expected seismic forces. Collector forces are transferred through horizontal reinforcing at the concrete walls, which is inadequate in the longitudinal direction, while the transverse shear walls run the length of the diaphragm to restrict the collector force to a negligible level. The building is founded on a series of strip footings that vary in width from 1’-0” to 2’-0”. The life safety hazards identified at the shop building are the inadequacies in wall anchorage connections, collector strength, concrete shear wall strength, and plywood shear wall strength.

Construction drawings for the music building were not available for review at the time of this assessment; therefore, no review was undertaken.

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.	Main Building, Wing 1: Concrete frames lack adequate shear strength and ductility to resist the expected seismic forces.
2.	Main Building, Wing 1: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
3.	Main Building, Wing 2: Concrete frames lack adequate shear strength and ductility to resist the expected seismic forces.
4.	Main Building, Wing 2: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
5.	Main Building, Wing 3: Concrete frames lack adequate shear strength and ductility to resist the expected seismic forces.
6.	Main Building, Wing 3: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
7	Main Building, Wing 4: Concrete frames lack adequate shear strength and ductility to resist the expected seismic forces.
8.	Main Building, Wing 4: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
9.	Main Building, Wing 5: Horizontal diaphragm truss composed of steel tension rods lacks adequate strength to resist the expected seismic forces.
10.	Main Building, Wing 5: Concrete wall anchorage connections lack adequate strength to transfer the expected out-of-plane seismic forces.
11.	Main Building, Wing 5: Concrete walls lack adequate flexural strength to resist the expected out-of-plane seismic forces.
12.	Main Building, Wing 5: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
13.	Main Building, Wing 5: Concrete walls with extensive window openings lack adequate shear strength to resist the expected seismic forces.
14.	Main Building, Library Wing: Concrete walls with extensive window openings lack adequate shear strength to resist the expected seismic forces.

Item	Building Structural Deficiencies
15.	Main Building, Library Wing: Concrete wall anchorage connections lack adequate strength to transfer the expected out-of-plane seismic forces.
16.	Main Building, Library: Concrete walls lack adequate flexural strength to resist the expected out-of-plane seismic forces.
17.	Main Building, Library Wing: Structure lacks structural diaphragm to transfer lateral loads to the concrete shear walls.
18.	Main Building, Library Wing: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
19.	Main Building, miscellaneous: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
20.	Main Building, miscellaneous: Concrete shear walls lacking at some locations.
21.	Main Building, miscellaneous: Corridor structures are connected to multiple building wings and lack the capacity to withstand differential displacements of these wings.
22.	Main Building, miscellaneous: Hard conduits between structures lack the capacity to withstand differential building displacements.
23.	Gymnasium Building: Concrete walls with extensive window openings lack adequate shear strength to resist the expected seismic forces.
24.	Gymnasium Building: Horizontal steel diaphragm truss lacks adequate strength to resist the expected seismic forces.
25.	Gymnasium Building: Concrete wall anchorage connections at the high roof lack adequate strength to transfer the expected out-of-plane seismic forces.
26.	Gymnasium Building: Concrete walls lack adequate flexural strength to resist the expected out-of-plane seismic forces.
27.	Gymnasium Building: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
28.	Shop Building: Concrete walls with extensive window openings lack adequate shear strength to resist the expected seismic forces.
29.	Shop Building: Chord/collector reinforcing and/or splices lack adequate tensile strength to resist the expected seismic forces.
30.	Shop Building: Plywood shear walls lack adequate shear strength to resist the expected seismic forces.
31.	Shop Building: Concrete wall anchorage connections at the roof lack adequate strength to transfer the expected out-of-plane seismic forces.

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	Figure Number
1.	Provide new concrete shear walls with dowels into the	1.0	3, 10, 11

Item	Recommended Remediation	Priority	Figure Number
	existing concrete columns and beams. Provide new concrete strip footings at the foundation.		
2.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A.
3.	Provide new concrete shear walls with dowels into the existing concrete columns and beams. Provide new concrete strip footings at the foundation.	1.0	10, 11
4.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A
5.	Provide new concrete shear walls with dowels into the existing concrete columns and beams. Provide new concrete strip footings at the foundation.	1.0	10, 11
6.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A.
7	Provide new concrete shear walls with dowels into the existing concrete columns and beams. Provide new concrete strip footings at the foundation.	1.0	5, 10, 11
8.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A.
9.	Provide new double angle members and connections with anchorage into lateral load resisting members to create a new horizontal diaphragm truss.	1.5	N.A.
10.	Strengthen concrete wall anchorage connections with new wall anchors and diaphragm ties.	1.1	N.A.
11.	Provide new steel “strong backs” from the floor to roof diaphragm with anchors into existing concrete walls.	1.5	N.A.
12.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A.
13.	Provide new concrete wall in-fill at existing window locations with dowels into the existing concrete walls. Provide new concrete strip footings at foundation where absent.	1.1	7
14.	Provide new concrete wall in-fill at existing window locations with dowels into the existing concrete walls. Provide new concrete strip footings at foundation where absent.	1.1	9
15.	Strengthen concrete wall anchorage connections with new wall anchors and diaphragm ties.	1.1	N.A.
16.	Provide new steel “strong backs” from the floor to roof diaphragm with anchors into existing concrete walls.	1.5	N.A.
17.	Provide new double angle members and connections with anchorage into lateral load resisting members to create a horizontal diaphragm truss.	1.2	N.A.

Item	Recommended Remediation	Priority	Figure Number
18.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A.
19.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A.
20.	Provide new concrete shear walls with dowels into the existing diaphragm. Provide new concrete strip footings at the foundation.	1.1	13
21.	Provide new seismic separation joints in the corridor structures to seismically separate the various wings of the building.	1.8	4, 8
22.	Provide new flexible conduit connections at critical locations.	1.9	N.A.
23.	Provide new concrete wall in-fill at existing window locations with dowels into the existing concrete walls.	1.1	14, 15, 18
24.	Provide new double angle members and connections with anchorage into lateral load resisting members to create a new horizontal diaphragm truss.	1.5	N.A.
25.	Strengthen concrete wall anchorage connections with new wall anchors and diaphragm ties.	1.1	N.A.
26.	Provide new steel “strong backs” from the floor to roof diaphragm with anchors into existing concrete walls.	1.5	N.A.
27.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A.
28.	Provide new concrete wall in-fill at existing window locations with dowels into the existing concrete walls.	1.1	19, 20
29.	Provide new steel chord/collector member with new anchors into shear walls and diaphragm.	1.2	N.A.
30.	Provide plywood sheathing and shear wall nailing on the unsheathed side of the existing walls. Add studs as required.	1.2	N.A.
31.	Strengthen concrete wall anchorage connections and plywood roof diaphragm with new wall anchors, diaphragm ties, and/or diaphragm nailing as required.	1.1	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 seismic retrofit work for this school campus be performed in Phase 1A.

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

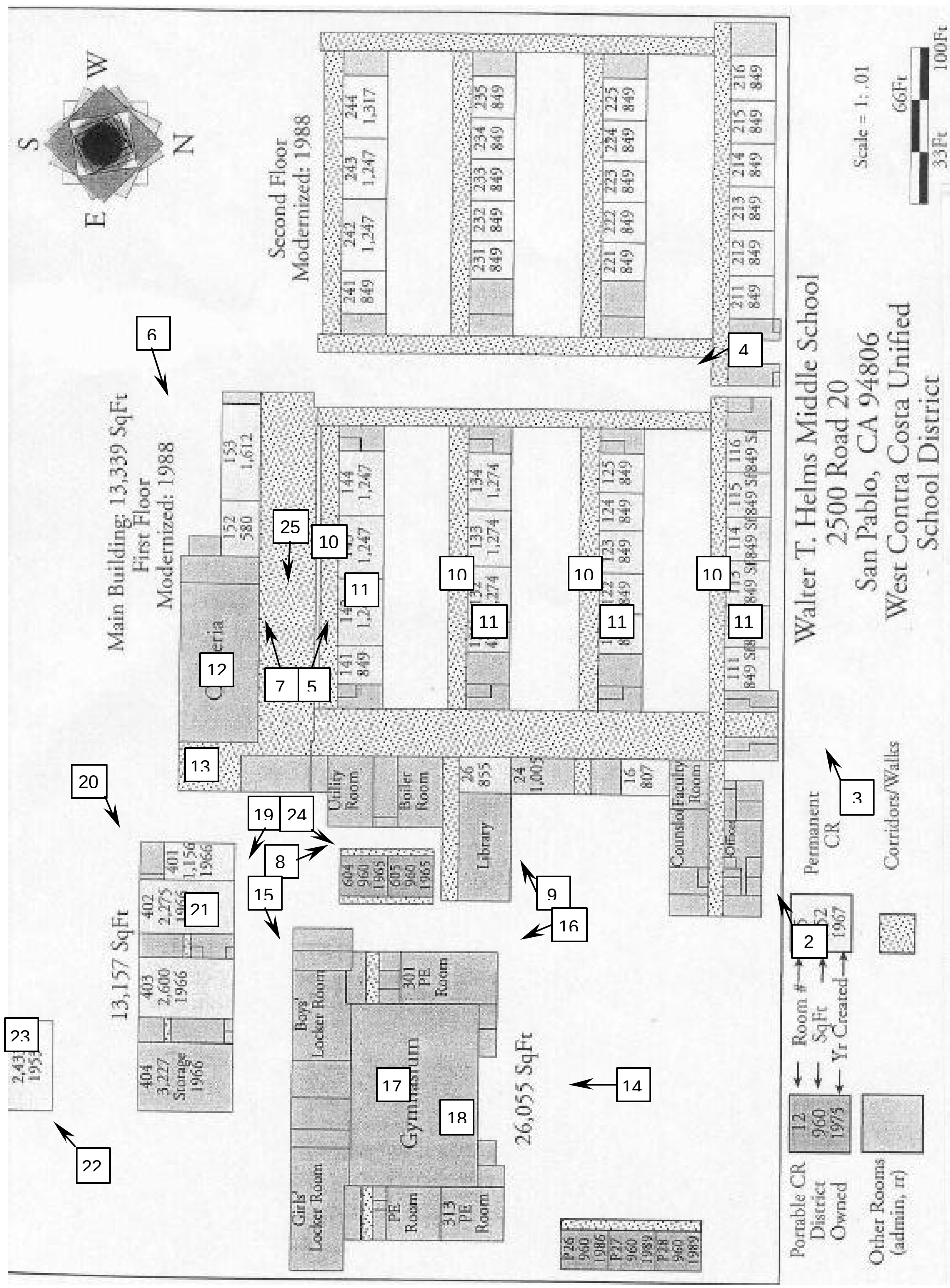


Figure 1: School Layout Plan

Figure 2: Main Building, administration wing, exterior north wall

Figure 3: Main Building, wing 1, exterior north wall

Figure 4: Main Building, exterior west wall

Figure 5: Main Building, wing 4, exterior south wall

Figure 6: Main Building, wing 5, exterior south wall

Figure 7: Main Building, wing 5, exterior north wall

Figure 8: Main Building, exterior east wall at boiler room

Figure 9: Main Building, library wing, exterior north wall

Figure 10: Main Building, classroom wings, interior at corridor

Figure 11: Main Building, classroom wings, interior at classroom

Figure 12: Main Building, wing 5, interior at cafeteria

Figure 13: Main Building, wing 5, interior at additional dining area

Figure 14: Gymnasium Building, exterior north wall

Figure 15: Gymnasium Building, exterior southwest corner

Figure 16: Gymnasium Building, exterior northwest corner

Figure 17: Gymnasium Building, interior at main gym area

Figure 18: Gymnasium Building, interior at north wall of main gym area

Figure 19: Shop Building, exterior north wall

Figure 20: Shop Building, exterior southwest corner

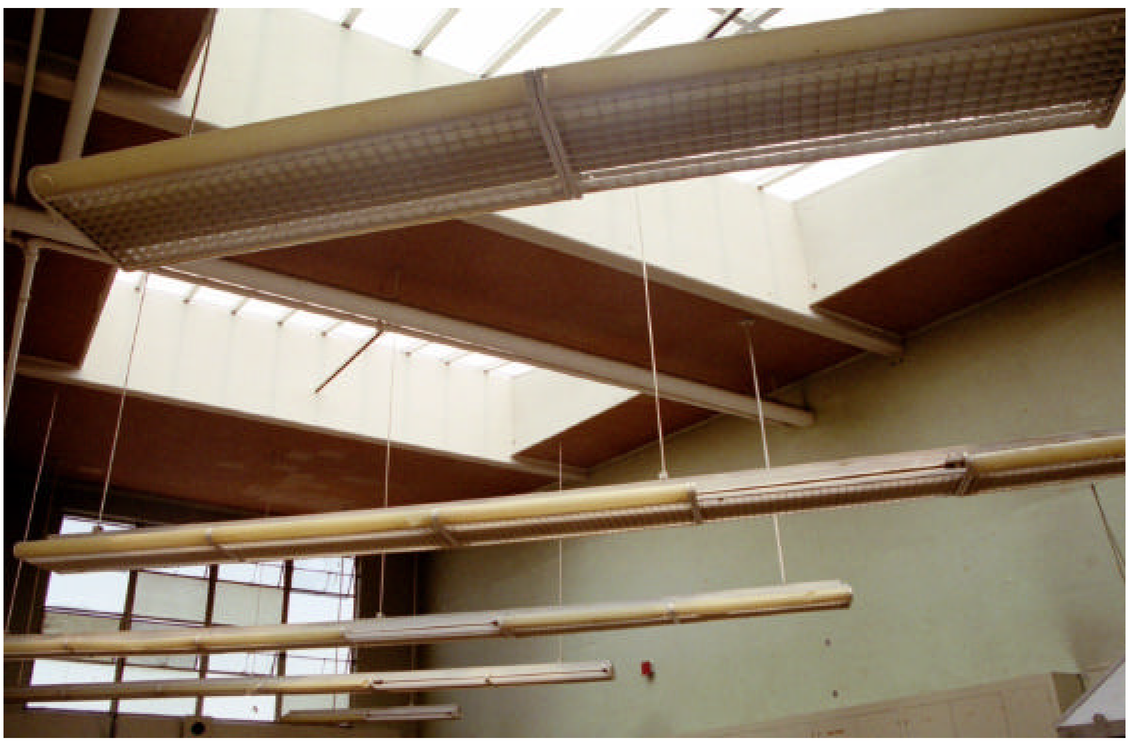


Figure 21: Shop Building, interior skylights

Figure 22: Music Building, exterior northeast corner

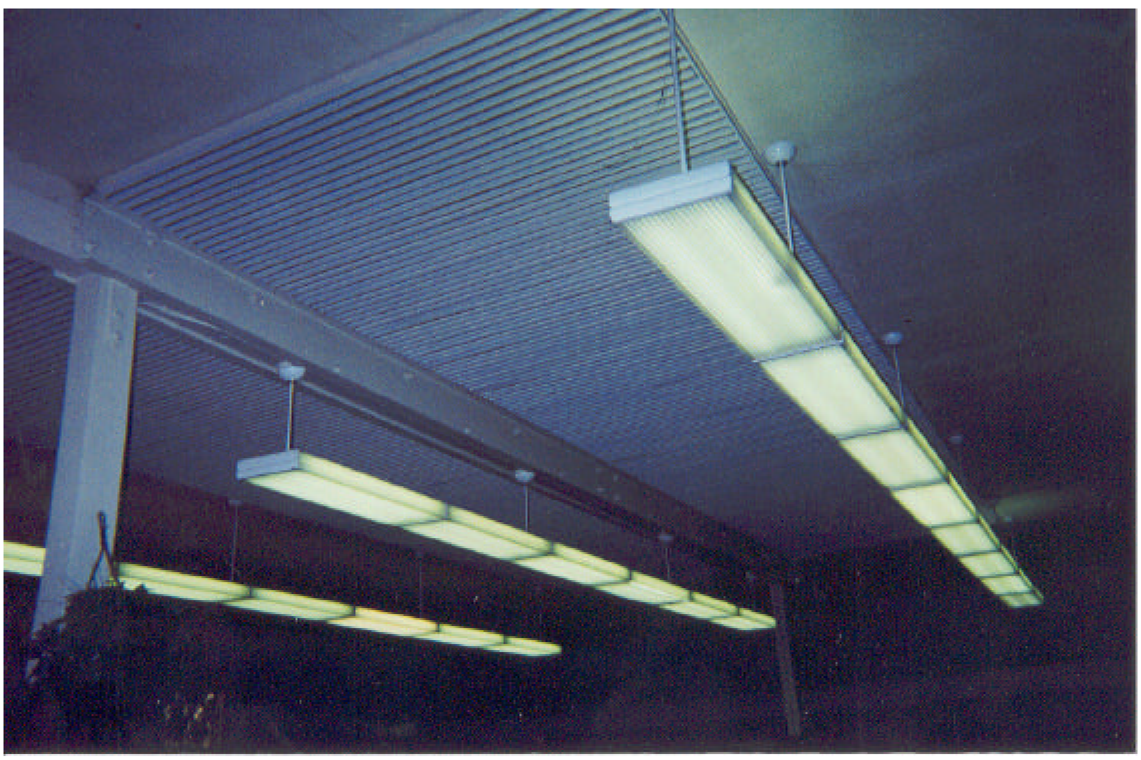
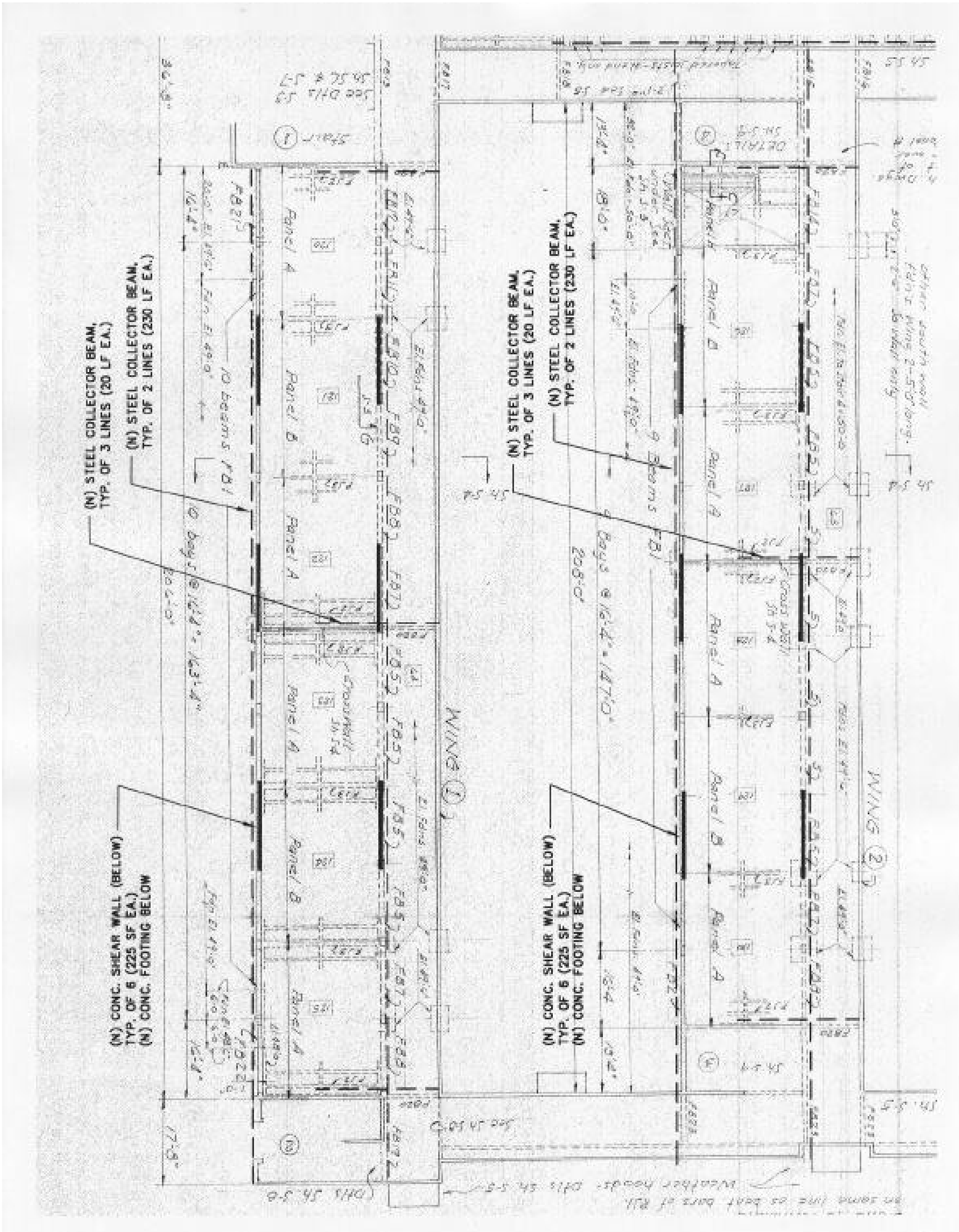


Figure 23: Music Building, interior

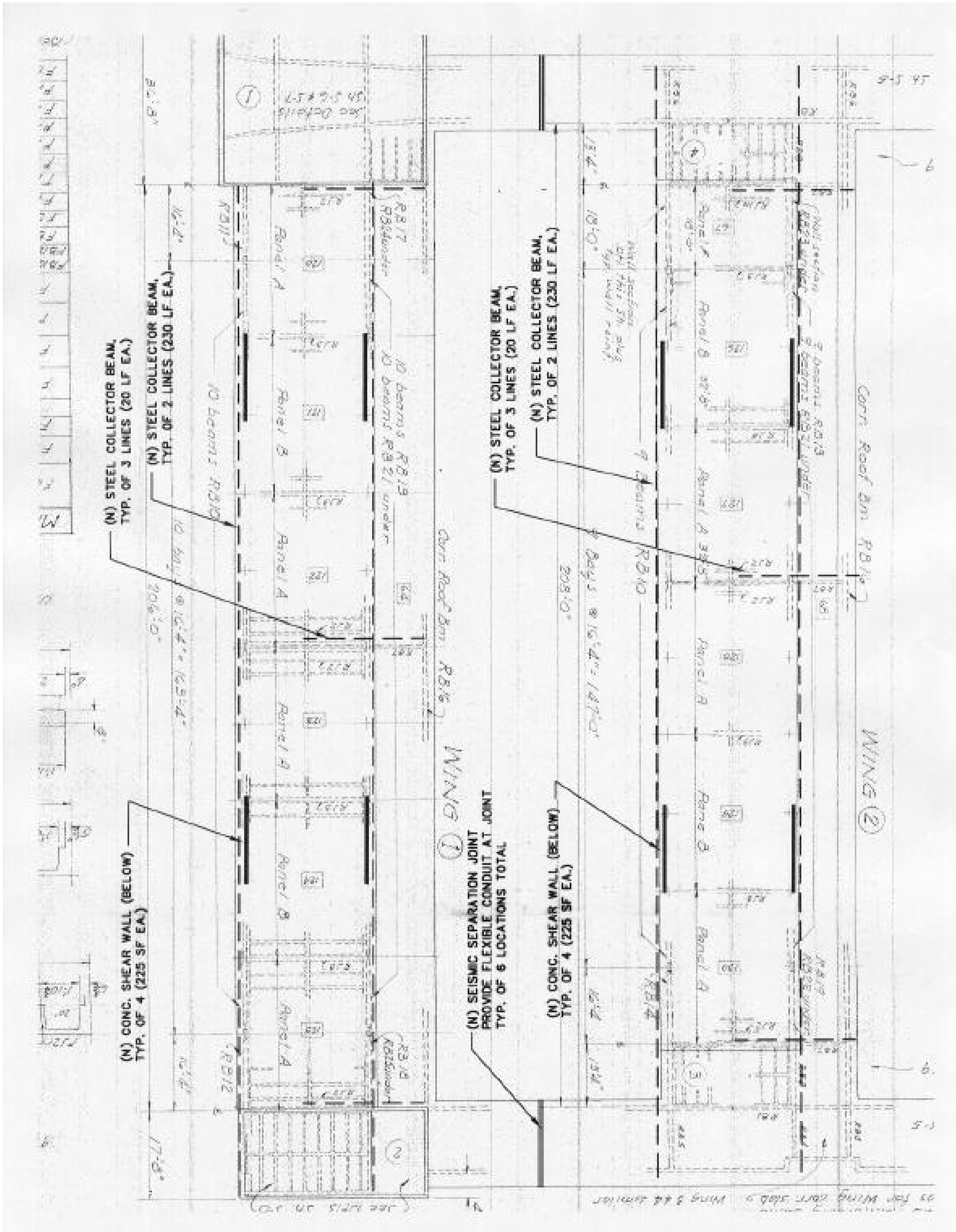
Figure 24: Portable Building, exterior

Figure 25: Outdoor dining structure

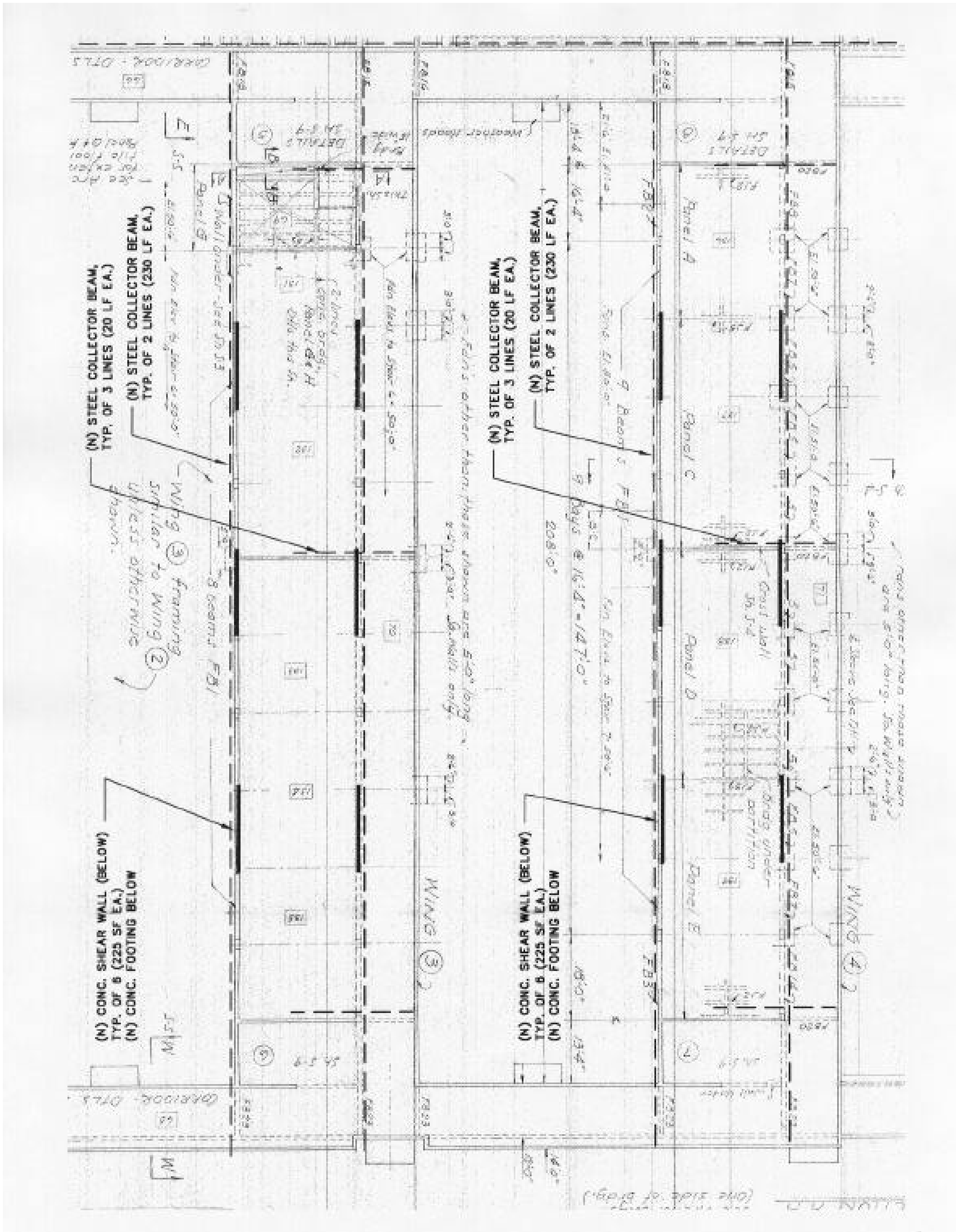
Appendix B: Drawings



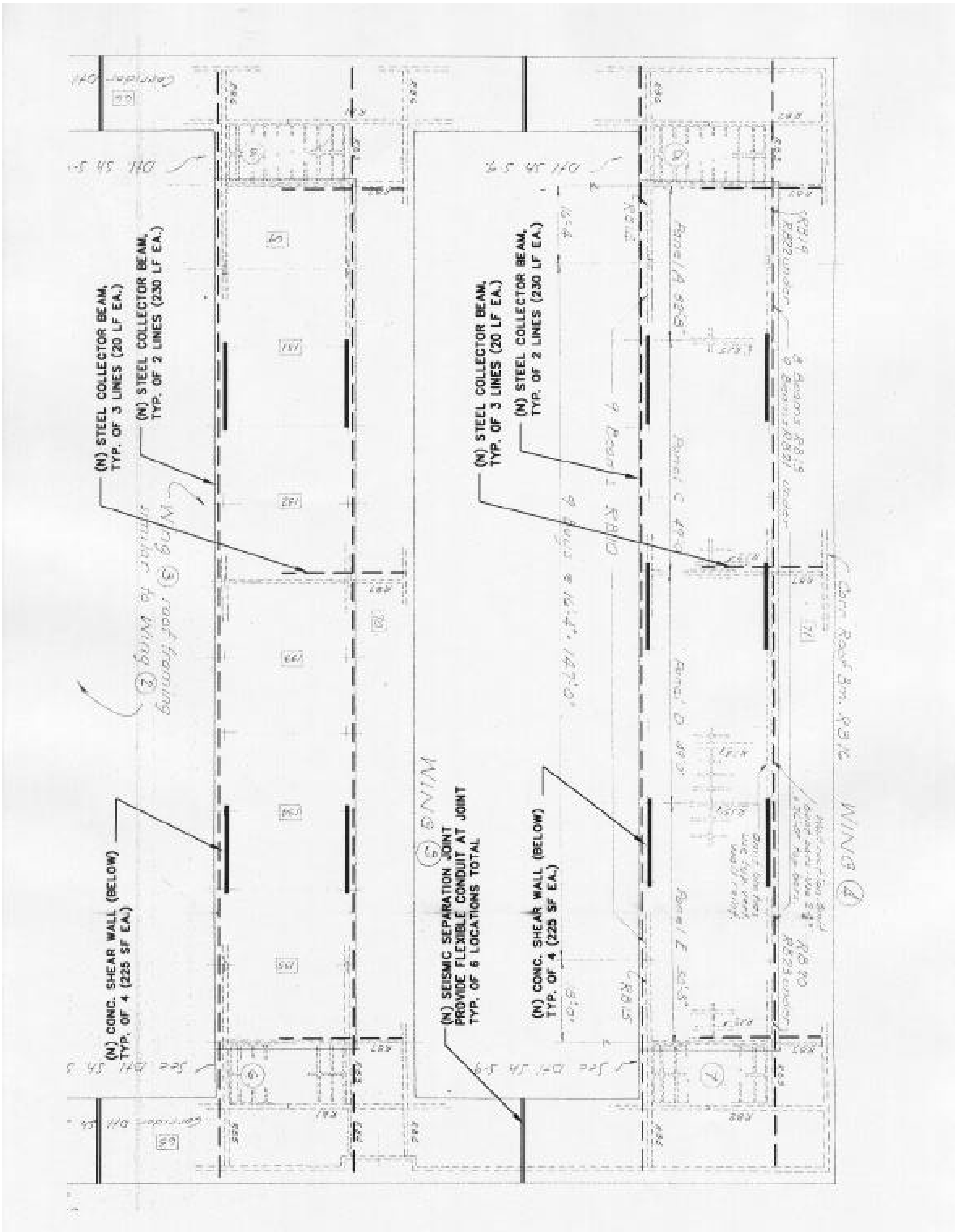
Drawing 1: Main Building, Wing 1 & 2 Floor Framing Plan



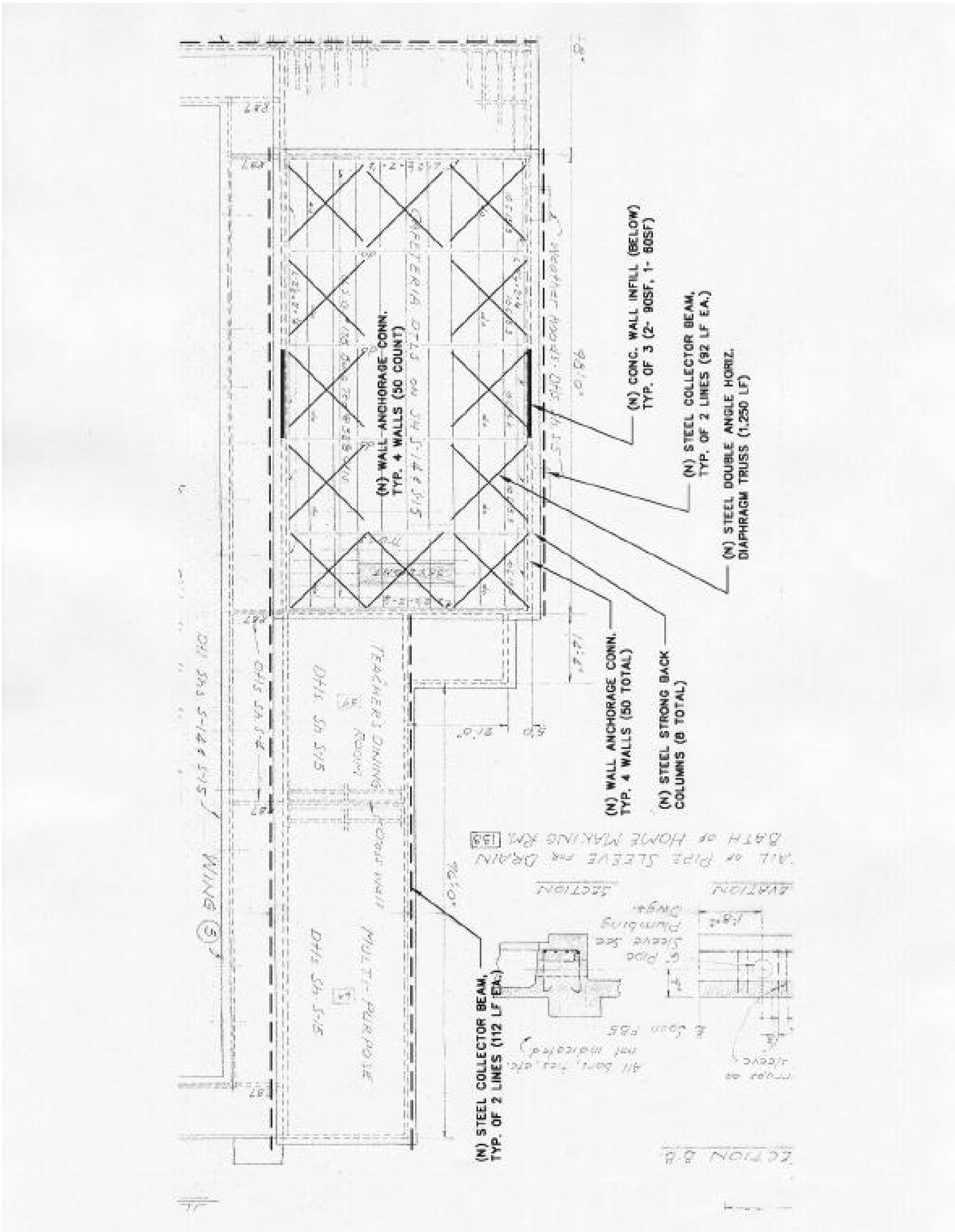
Drawing 2: Main Building, Wing 1 & 2 Roof Framing Plan



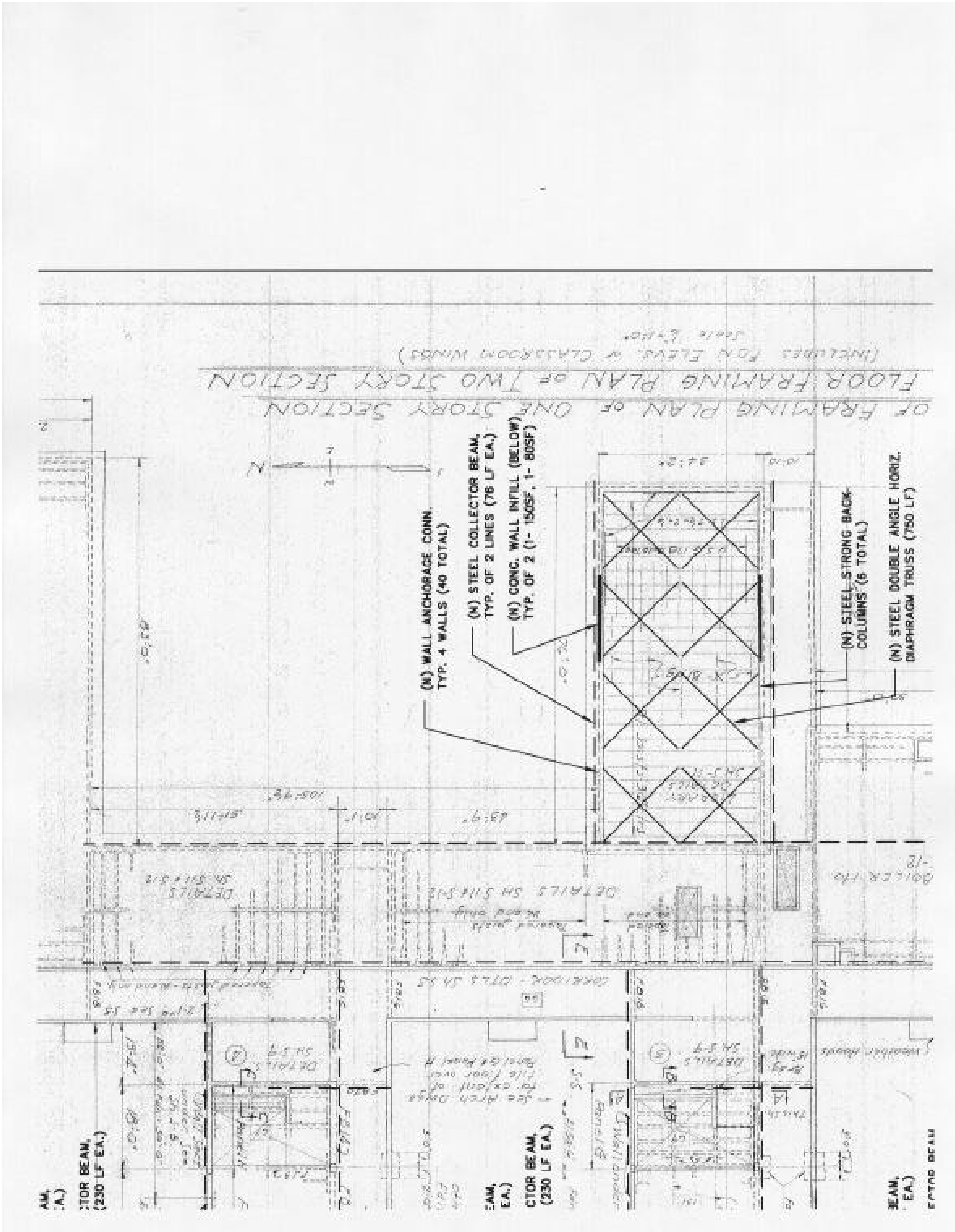
Drawing 3: Main Building, Wing 3 & 4 Floor Framing Plan



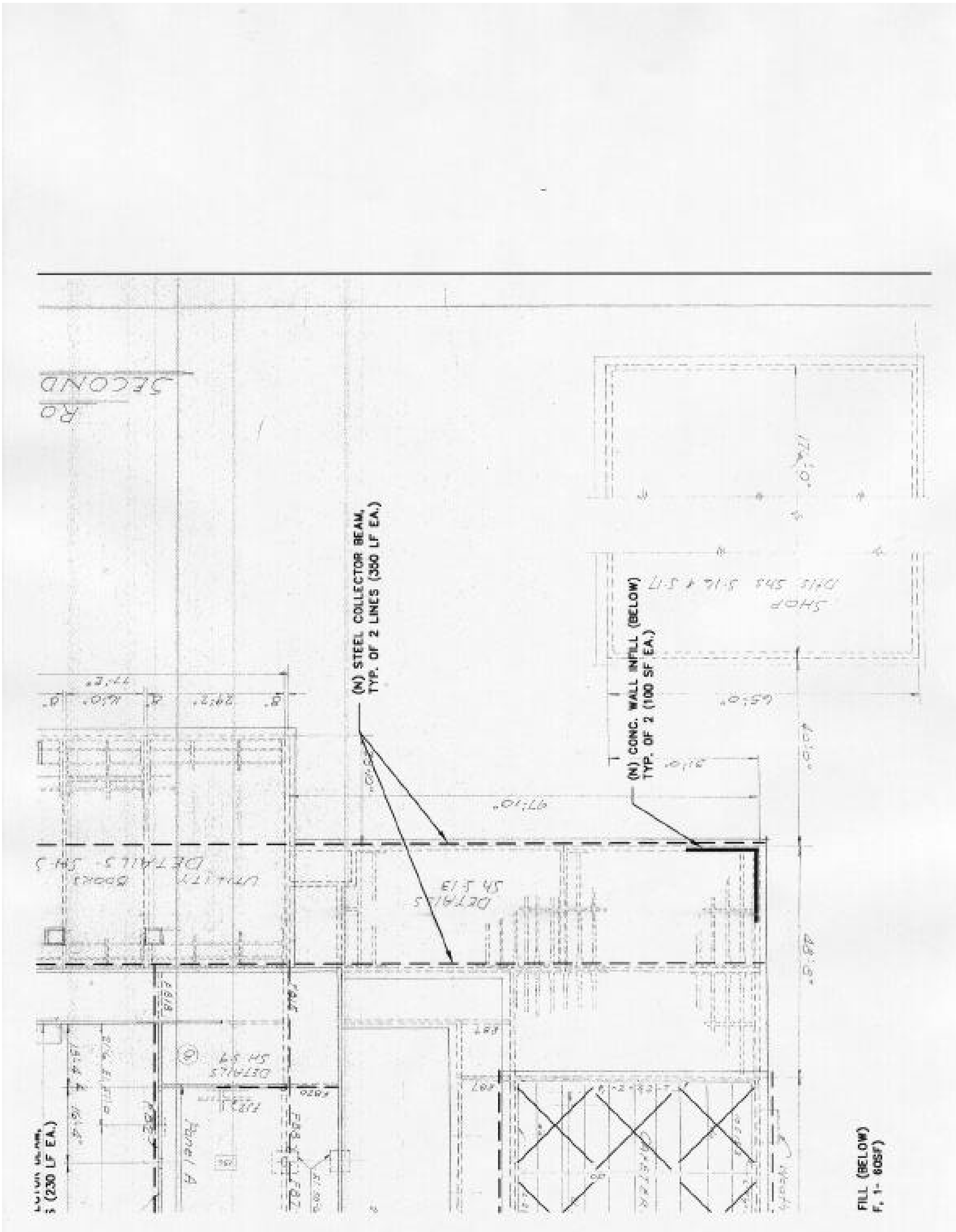
Drawing 4: Main Building, Wing 3 & 4 Roof Framing Plan



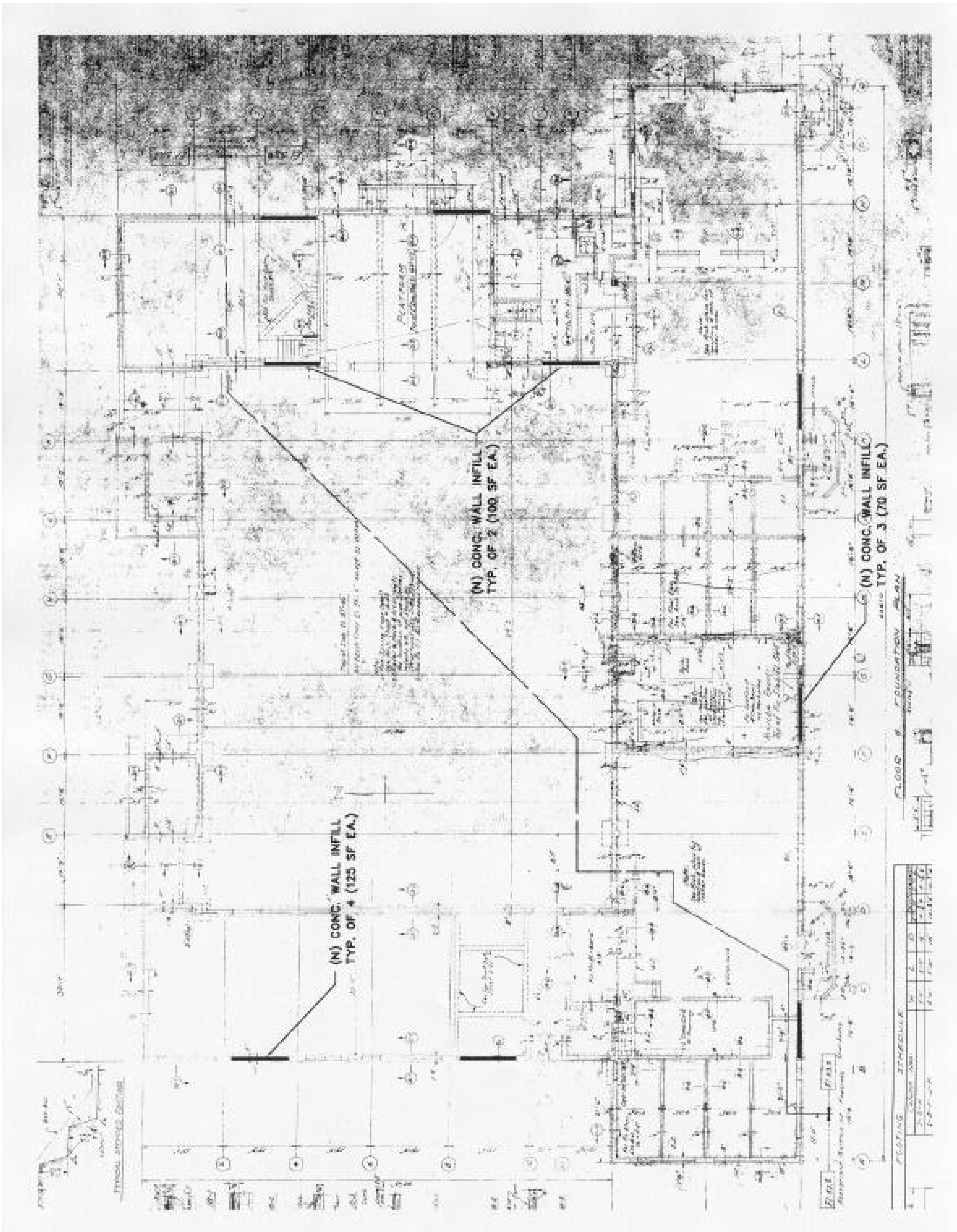
Drawing 5: Main Building, Wing 5 Roof Framing Plan



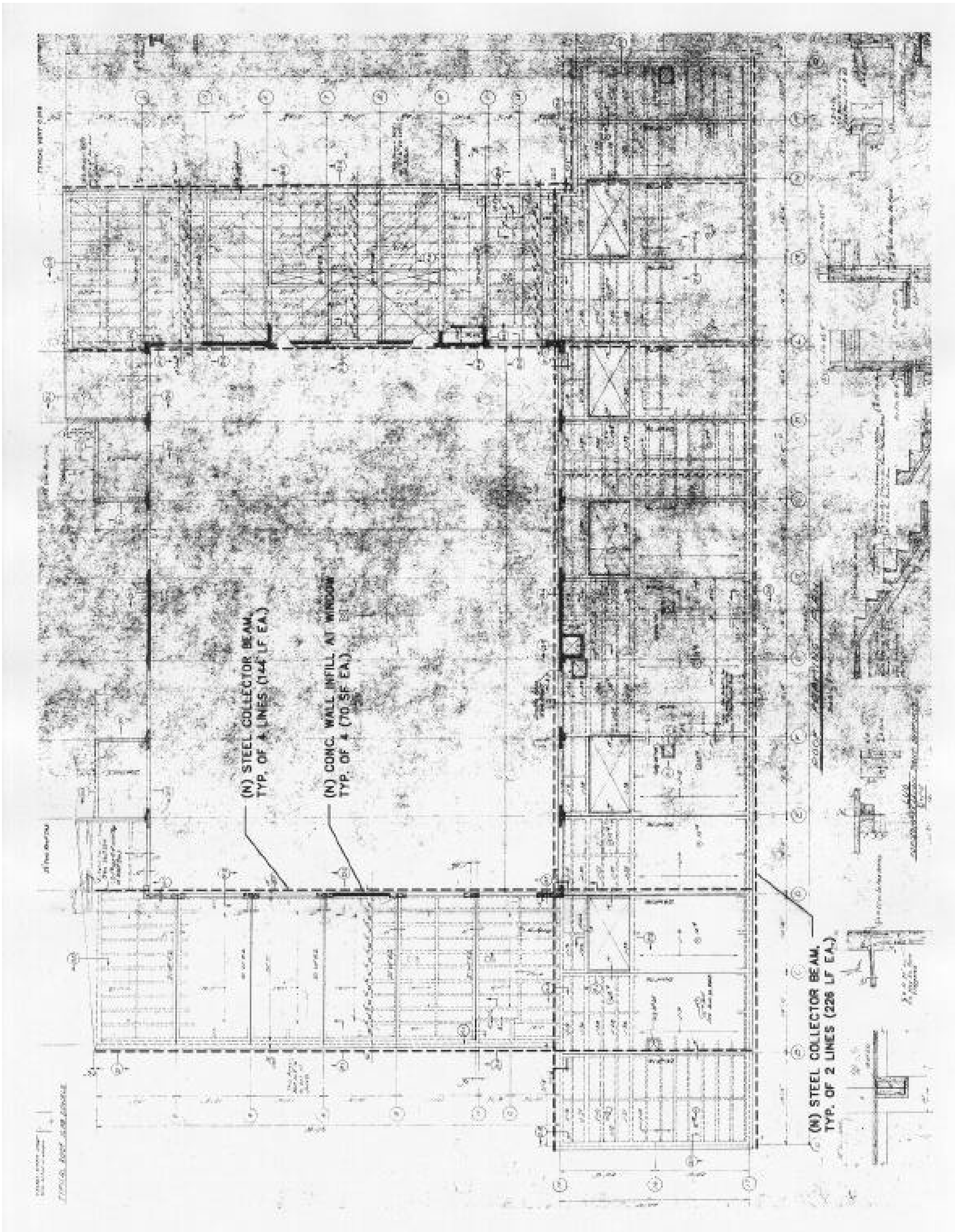
Drawing 6: Main Building, Library Wing Roof Framing Plan



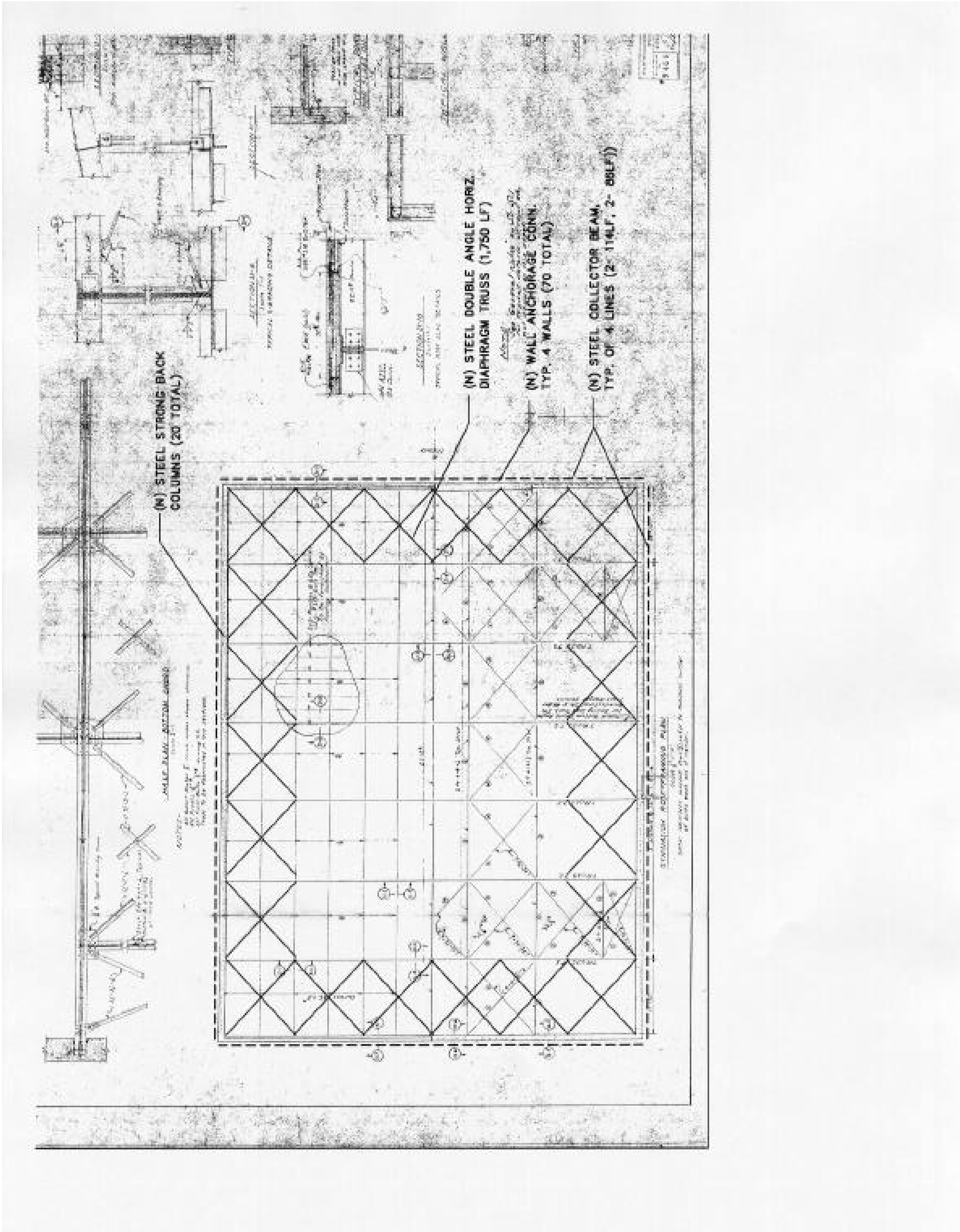
Drawing 7: Main Building, Miscellaneous Roof Framing Plan



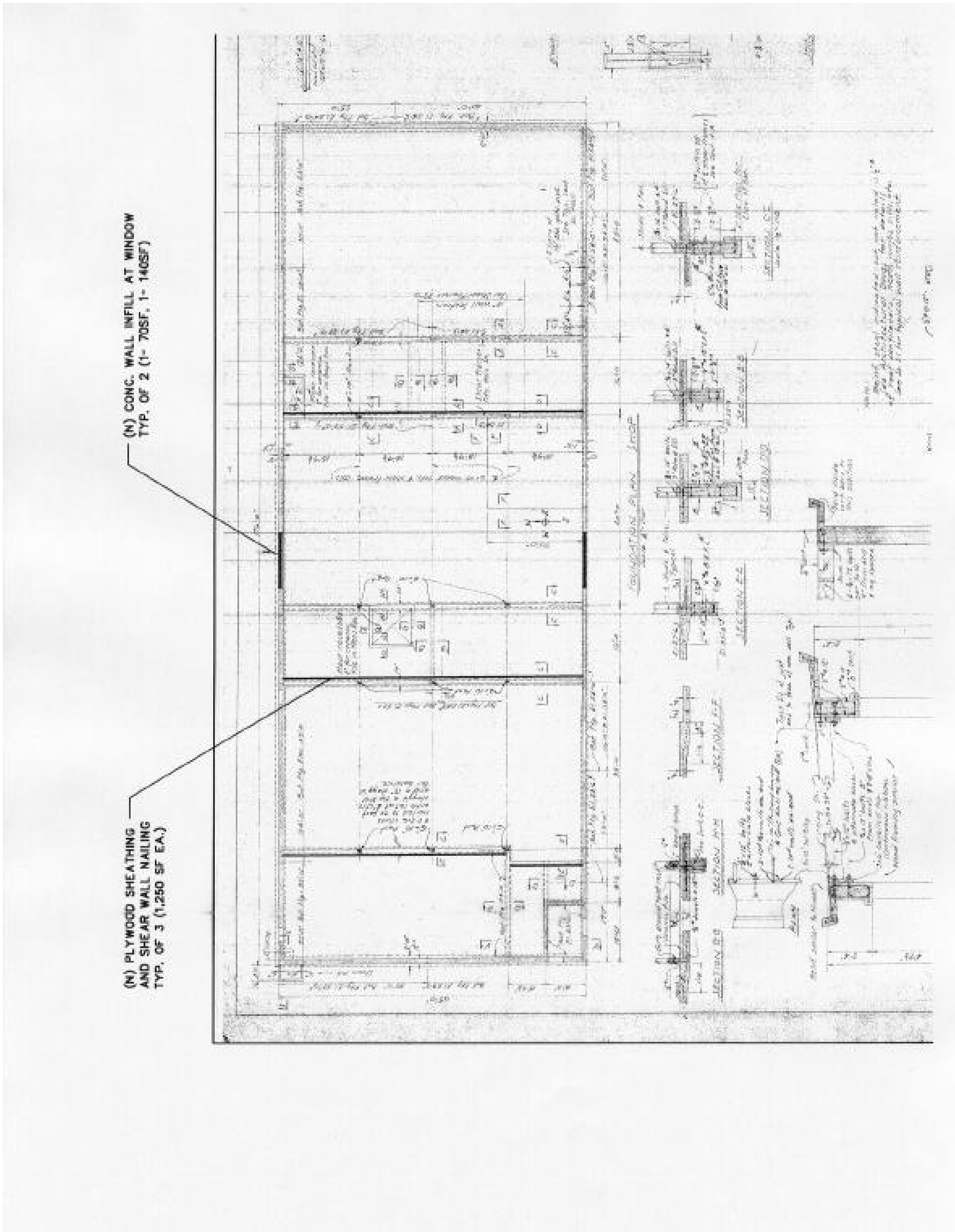
Drawing 8: Gymnasium Building, Foundation Plan



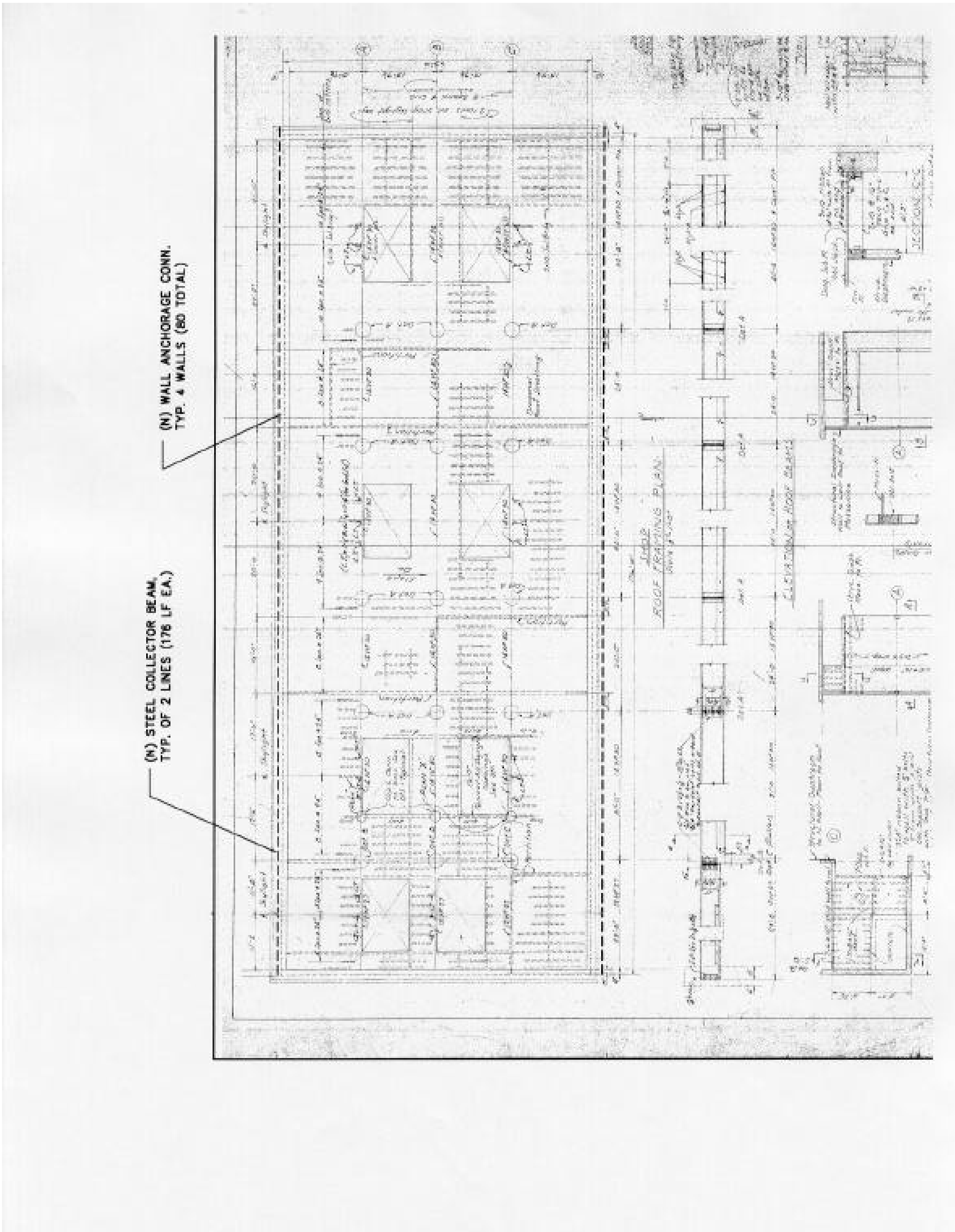
Drawing 9: Gymnasium Building, Low Roof Framing Plan



Drawing 10: Gymnasium Building, High Roof Framing Plan



Drawing 11: Shop Building, Foundation Plan



Drawing 12: Shop Building, Roof Framing Plan