

SIERRA SANDS UNIFIED SCHOOL DISTRICT

MEEHLEIS MODULAR BUILDINGS

NEW MURRAY MIDDLE SCHOOL

SUMMARY OF GYMNASIUM RESISTANCE TO BLAST LOADS

PHASE 1



PROTECTIVE TECHNOLOGIES GROUP

FEBRUARY 4, 2016

BY

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SECTION 1: GENERAL

The following report provides a summary of the capability of the proposed gymnasium (Building B) for the SSUSD Murray Middle School project to resist the design blast loads and provide a Low Level of Protection (LLOP) per UFC 4-010-01. Structural components and connections have been analyzed using single-degree-of-freedom methods, finite element analyses, and hand calculations. The drawings referenced in Section 2 are found in the Baseline Drawings and Kipp King Collegiate High School structural set provided by Meehleis Modular Buildings. In general, analyses show that nearly all structural members can be used as shown, but many connections require upgrade. The following comments and assumptions are applicable to the response summary found in Section 2:

- It is assumed that NAVFAC will accept the use of Douglas-Fir Larch wood studs and a wall supported weight in the range of 8-12 psf to qualify as Conventional Construction per UFC 4-010-01.
- Required nailing and straps around shear wall openings will need to be determined in Phase 2.
- Local effects due to roof supported components such as heat pumps or mechanical systems will not be evaluated until actual locations have been finalized.
- It is assumed that a seismic separation joint will be located between the main gymnasium building and annex, with the final dimension to be coordinated with PTG in Phase 2.
- Windows and door supporting elements will be discussed in a subsequent Phase 1 report.
- It is assumed that roof overhangs/eaves will not be used for the gymnasium or adjacent annex.
- It is assumed that blocking will be provided at all wood panel edges for roof and shearwall diaphragms.
- Foundation design/analysis work will be conducted during Phase 2 if required.
- Changes to the configurations shown in the provided drawings will likely require additional analysis. It is important to note that stronger members than those shown will have a significant effect on reaction forces and, thus, negate the validity of completed blast analyses. Stronger members do not necessarily correspond to an equivalent level of protection for blast.
- Adjustments for members or connections marked “No Good” are provided with a reasonably high level of confidence but cannot be guaranteed until Phase 2. These adjustment notes are provided to develop a more realistic baseline and expectation of the magnitude of required changes to resist the design blast loads.
- In addition to providing the response of components and connections to the design blast loads, Protective Technologies Group has made a best effort to begin considering upgrade options where insufficient components exist. After review of this report, a follow-up meeting will be needed to discuss such considerations and the options available.

SECTION 2: RESPONSE SUMMARY BY COMPONENT

Bldg.	Part	Section	Detail(s) / Drawing(s)	Member	Connections
Main	Roof Purlin	C6x4x14ga	Multiple	OK	OK
Main	Truss Verticals	L3x3x1/4"	1/S-3B, 12/S-2A.1R, 15/S-2A.1R	OK	No Good (See Note 1.)
Main	Truss Diagonals	L3x3x1/4"	1/S-3B, 12/S-2A.1R	OK	No Good (See Note 2.)
Main	Truss Top Chord	L6x4x3/8"	Multiple	OK	OK
Main	Truss Bottom Chord	L6x4x3/8"	Multiple	OK	OK
Main	Diagonal Braces Between Trusses	L3x3x1/4"	14/S-2.1	OK	OK
Main	Chord Ties	0.25"x3" Steel Straps	1A/S-2.1, 13/S-2.1	OK	OK
Main	Roof Materials	(See Note 3.)	1/S-3B, R3/S-3A1	OK	No Good (See Note 4.)
Main	Steel Roof Header Beam	C36x4.5x10ga	1/S-3B, R3/S-3A1	TBD (See Note 5.)	No Good (See Note 5.)
Main	Wood Studs	2x12 @ 16" o.c., 23'-3.5"	R3/S-3A1, F3/S-3A1	OK (See Note 6.)	No Good (See Note 5.)
Main	Top Plates	2x12 (Qty 2)	R3/S-3A1	No Good (See Note 5.)	No Good (See Note 5.)
Main	Bottom Plate	2x12	F3/S-3A1	No Good (See Note 5.)	No Good (See Note 5.)
Main	Sill Plate	4x12	S-3A1 / F3	OK	No Good (See Notes 5 and 14.)
Main	Wall Fiber Cement Lap Siding	5/16"	R3/S-3A1	OK	OK
Main	Wall Plywood / OSB	1/2"	R3/S-3A1, F3/S-3A1	OK	No Good (Change Edge Nailing to 4")
Main	Wall Gyp Board	1/2"	R3/S-3A1, F3/S-3A1	OK	OK
Main	Wall Acoustical Panels	TBD	R3/S-3A1, F3/S-3A1	OK	OK

Bldg.	Part	Section	Detail(s) / Drawing(s)	Member	Connections
Annex	Steel Roof Beam	C20x4.5x10ga, 36.5 ft	2/S-3B	OK (See Note 7.)	No Good (See Note 8.)
Annex	Steel Roof Header Beam	C20x6.5x10ga	R1/S-3A1	TBD (See Note 9)	No Good (See Notes 8 and 10.)
Annex	Floor Beam	HSS6x2x1/4"	F1/S-3A1	OK	OK
Annex	Wood Backing	2x6	F1/S-3A1	OK	OK
Annex	Wood Sill Plate	2x6	F1/S-3A1	OK	OK
Annex	Wood Studs	2x6 @ 16" o.c.	F1/S-3A1, R1/S-3A1	OK	OK (See Note 11.)
Annex	Wall Plywood / OSB	1/2"	R1/S-3A1, F1/S-3A1	No Good (Use 3/4" OSB)	OK
Annex	Wall Fiber Cement Lap Siding	5/16"	R1/S-3A1, F1/S-3A1	OK	OK
Annex	Wall Gyp Board	5/8"	F1/S-3A1, R1/S-3A1	OK	OK
Annex	Top Plates	2x6 (Qty. 2)	R1/S-3A1	OK	No Good (See Note 11.)
Annex	Bottom Plate	2x6	F1/S-3A1	OK	OK
Annex	Sill Plate	4x6	F1/S-3A1	OK	OK
Annex	All Parapet Components	Multiple	R1/S-3A1	OK	OK
Annex	Roof Materials	(See Note 12.)	R1/S-3A1	OK	OK
Annex	Chord Ties	0.25"x3" Steel Straps	1/S-2.A.2	OK	OK w/bolts (See Note 13.)

Notes:

- 1) Weld length provided in Example Gymnasium drawings indicates 1 1/2" of weld each side of angle for a total weld length provided of 3". Weld is inadequate, upgrade required. Provide 2 1/2" of weld each side of angle for a total weld length provided of 5" at a minimum. To be confirmed in Phase 2 analysis.
- 2) Weld provided in Example Gymnasium drawings indicates a total weld length provided of 3". Weld is inadequate and will require a continuous weld at joint at a minimum. Minor upgrade in maximum shear regions of the truss may be required. To be confirmed in Phase 2 analysis.
- 3) Roof section consists of Standing Seam Metal Roof over Cover Board over R30 Rigid Insulation over 3/4" T&G Plywood T&G. OSB is not acceptable.

- 4) Minimums: boundary nailing @ 4", edge nailing @ 6", field nailing @ 12", fasteners with diameter = .148", 1.5" penetration into wood members.
- 5) A35 clips, 5/8" metal bolts @ 32" o.c., and top plate nailing insufficient for out-of-plane shear, in-plane shear, and uplift from roof rebound (uplift) due to blast. Use 3 or 4 A35 clips for typical studs (out-of-plane shear). Multiple A35 clips and significant tie-down mechanisms (example for estimating: 2 Simpson Strong-Tie HDQ8-SDS3 at top and bottom of double studs at truss supports, 4 total holdowns at each double stud) will be required at locations where roof truss ends bear on wall (every 12 ft along 2 walls). Our team would like to discuss details of this connection with your team. Because the response of the top plates and C36x4.5x10ga beam is dependent on the nature of the upgraded connection scheme, Phase 2 work will be required to provide an accurate analysis of this cold-formed section. For estimating purposes, it should be expected that this beam will require 10 gage stiffener plates at 4'-0" o.c. at a minimum.
- 6) Double 2x12 stud required at roof truss connection locations. Other typical locations are OK for 2x12 studs @ 16" o.c.
- 7) Beam is OK if 10 gage stiffener plates are used at locations within 4 ft and 8 ft of beam ends for both interior and exterior beams. Typical spacing of 4 ft (exterior beams) and 8 ft (interior beams) is OK at other locations.
- 8) Connections between ends of each truss, roof header beams, and stud wall are insufficient for uplift from roof rebound due to blast.
- 9) Because the response of the C20x6.5x10ga beam is dependent on the nature of the upgraded connection scheme, Phase 2 work will be required to provide an accurate analysis of this cold-formed section. For estimating purposes, it should be expected that this beam will require 10 gage stiffener plates at 5'-0" o.c. at a minimum.
- 10) Connection of roof to stud walls is insufficient for in-plane wall shear.
- 11) Double 2x6 stud required at locations where 36'-6" roof beam ends bear on wall. Significant tie-down mechanisms (example for estimating: 2 Simpson Strong-Tie HDQ8-SDS3 at top and bottom of double studs at beam supports, 4 total holdowns at each double stud) will be required at these locations due to roof rebound (uplift) load.
- 12) Roof section consists of Class-A Single Ply Roofing over 1/2" Substrate over R30 Rigid Insulation over 18 Gage Metal B-Deck.
- 13) If welded option is selected, increase weld from 3" to 4" at top and bottom of each strap (8" total weld at each end of each strap).
- 14) The requirement for sill bolts can be estimated at this point to be on the order of 5/8" diameter at 16" o.c., minimum.