

# SHAPTON & PARTNERS INC.

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Jack B. Shapton, SE

June 22, 2001

Mr. Dean McKee  
Permit Center Director City  
of Woodinville 17301 133rd  
Avenue NE Woodinville, WA  
98072

Subject: Seismic Evaluation of City of Woodinville Annex Building Dear

Dean:

I have completed my FEMA 178 seismic evaluation of the subject building. The evaluation procedure outlined in Appendix C was utilized. Appendix C addresses unreinforced masonry (URM) bearing wall buildings and its performance objective is "**significant hazard reduction**". This is a lower performance objective than that prescribed for buildings of other construction types. To give perspective to this statement, if URM construction was allowed today, the force level would be approximately 100% higher than that used for this analysis and, if the standard FEMA 178 procedure for existing buildings was employed, the force level would be approximately 70% higher.

The goal of this evaluation was to identify and quantify deficiencies or "weak links" in the structure. Deficiencies found are as follows:

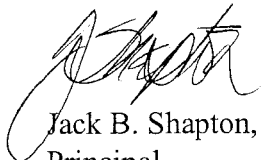
1. Horizontal loads originating from parts of the building which are remote from the shear resisting elements must be tied to the shear walls to provide for load transfer. The elements are known as collectors and are part of the floor/roof diaphragm construction. These elements are currently non-existent. This is a serious hazard since the diaphragms could fail prior to transferring horizontal shears to the shear resisting elements.
2. There is a deficiency in the wall-diaphragm anchors, both for transferring shear and for anchoring the walls for out-of-plane forces. This is a very serious hazard since the walls could separate from the diaphragms and be thrown outward allowing the roof and floor to collapse.
3. There is a deficiency in the strength of the diagonally sheathed wood shear walls along Line A (SK-1). This is a serious hazard as the failure of this line of bracing could be followed by the collapse of the building.

4. There is a potential deficiency with the anchorage of the brick veneer associated with the 1948 construction. Destructive investigation was not performed to verify veneer anchorage as determination of same can be verified when and if new shear resisting elements are provided along line A. However, as no veneer anchors were detailed in the 1948 documents, their presence should not be assumed.

In April 1999, FEMA published FEMA 276. This document contains information on probable costs of seismic rehabilitation. Based on this document, and in 1996 dollars, a probable cost for correcting noted deficiencies could range between \$22-\$41 per square foot. The gross square footage of this building is approximately 18,300 sf.

Practically speaking, this structure has withstood at least three major seismic events without any appreciable damage. As repair work is currently being budgeted for the localized damage suffered subsequent to our February earthquake, you may want to consider linking noted deficiency mitigation with any contemplated additions, alterations, or occupancy changes that would necessitate prolonging the useful life of this structure.

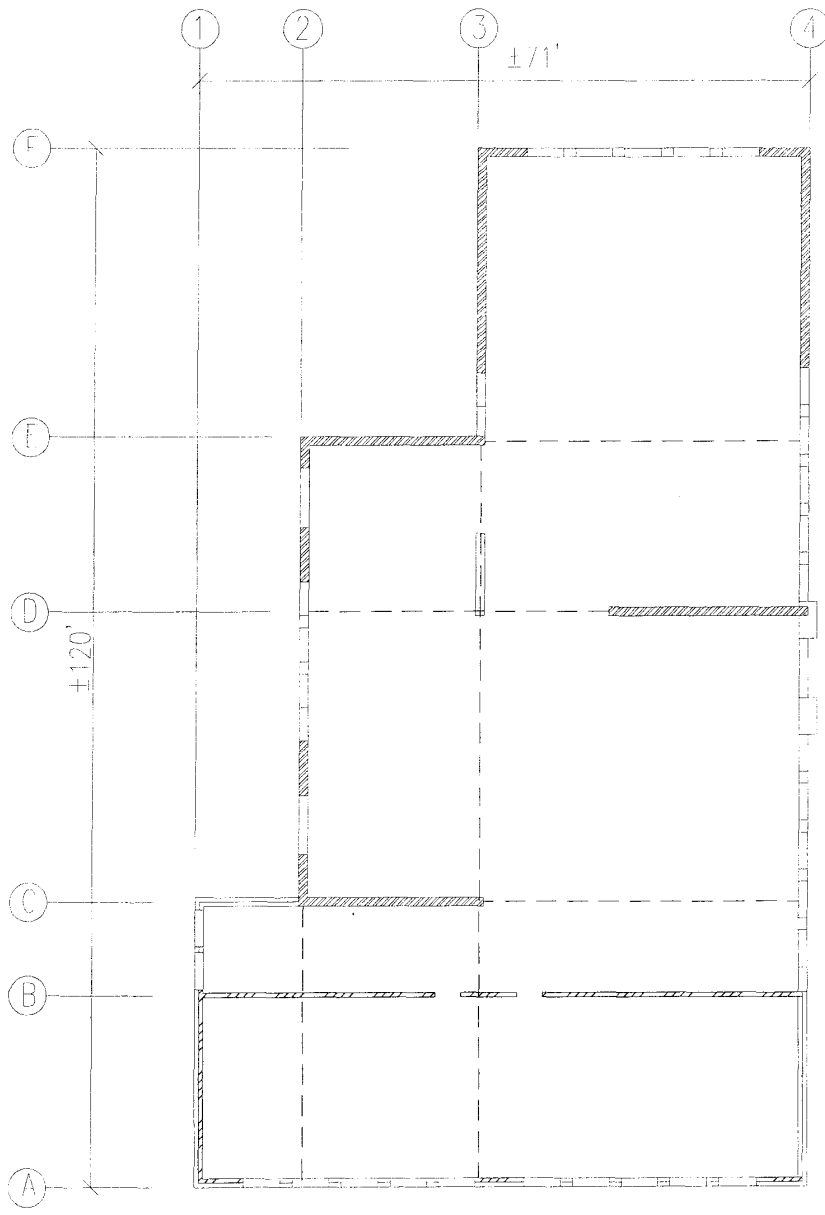
Respectfully,







Jack B. Shapton, S.E.  
Principal  
SHAPTON & PARTNERS



EXPIRES 11/20/06



-  CROSSWALL
-  SHIPLAP SHEAR WALL
-  MASONRY SHEAR WALL
-  PROPOSED COLLECTOR

KEY PLAN  
NO SCALE



SHAPTON & PARTNERS, INC. CONSULTING ENGINEERS	WOODINVILLE SCHOOL 13203 NE 175TH STREET SEISMIC EVALUATION	DATE: 06/22/01
		DETAIL NO. SK-1
FILE NO: 03502		

Chapter 7: Masonry Building Rehabilitation Examples and Cost Estimates

**Table 7-9 Typical Mean Costs Per Square foot and Cost Range for 50% Confidence, for the Seismic Rehabilitation of Types URM and URMA—Unreinforced Masonry Bearing-Wall Buildings**

Seismicity		Performance Level			
		Life Safety		Immediate Occupancy	
		Structural Costs	Project Costs	Structural Costs	Project Costs
Low: $S_T < 0.067$	Mean Cost:	\$10	\$22	\$21	\$42
	Cost Range:	\$5 - \$22	\$11 - \$46	\$10 - \$43	\$20 - \$85
Moderate: $0.067 \leq S_T < 0.2$	Mean Cost:	\$12	\$24	\$24	\$52
	Cost Range:	\$6 - \$25	\$12 - \$50	\$12 - \$49	\$25 - \$106
High: $S_T \geq 0.2$	Mean Cost:	\$20	\$41	\$36	\$75
	Cost Range:	\$10 - \$42	\$20 - \$84	\$17 - \$73	\$37 - \$155

$S_T$ : horizontal spectral acceleration (g) on firm rock for 1-second period, at 5% damping, with 10% probability of exceedance in 50 years.

**Table 7-10 Typical Cost Calculation for Seismic Rehabilitation: URM, URMA—Unreinforced Masonry Bearing-Wall Buildings**

	Life Safety	Immediate Occupancy
Group Mean Cost, $C_1$ : URM = Building Group 1	\$15.29	
Area Adjustment Factor, $C_2$ : Medium Sized Building (10,000—49,999 sq. ft.)	1.00	
Seismicity/Performance Level Factor, $C_3$		
Low Seismicity	0.61	1.21
Moderate Seismicity	0.70	1.40
High Seismicity	1.18	2.08
Architectural/Nonstructural Cost, $C_{NS}$		
Low Seismicity	\$6	\$10
Moderate Seismicity	\$6	\$14
High Seismicity	\$10	\$20
Project Cost Adjustment Factor, $C_{PM}$ : 30% Increase	1.30	
Location Adjustment Factor, $C_L$ : Missouri	1.00	
Time Adjustment Factor, $C_T$ : 1996 Dollars, 4% Average Inflation	1.12	
TYPICAL STRUCTURAL COST, $C_{TS} = C_1 * C_2 * C_3 * C_L * C_T$		
Low Seismicity	\$10	\$21
Moderate Seismicity	\$12	\$24
High Seismicity	\$20	\$36
TYPICAL PROJECT COST, $C_{TP} = (C_1 * C_2 * C_3 + C_{NS}) * C_{PM} * C_L * C_T$		
Low Seismicity	\$22	\$42
Moderate Seismicity	\$24	\$52
High Seismicity	\$41	\$75
Confidence Range Limits: 50% Confidence, One Building Considered		
Lower Bound = $C_{RL} * C_{TP}$ (or $C_{TS}$ )	$C_{RL} = 0.49$	
Upper Bound = $C_{RU} * C_{TP}$ (or $C_{TS}$ )	$C_{RU} = 2.06$	

Notes:

- Costs for disabled access improvements, hazardous material removal, or historic preservation are not included.
- Costs are 1996 dollars, per square foot, based on the economic conditions in the state of Missouri at that time.

Seismic Evaluation June  
21, 2001

## **BUILDING DESCRIPTION**

The existing structure is a two-story plus basement unreinforced masonry (URM) building, approximately 71 ft x 120' in plan (SK-1) and totaling approximately 18,300 sf (4,800 sf basement, 6,750 sf 1<sup>st</sup> fl, 6,750 sf 2<sup>nd</sup> fl). The building was constructed in three phases. The portion north of Line 3 and west of line D was constructed pre-1936. The remaining portion west of Line C was designed and presumably constructed in 1936. The portion east of Line C was designed and presumably constructed in 1948. Existing construction documents were provided for both the 1936 and 1948 work. All work prior to the 1948 addition is provided lateral support by URM walls. The 1948 work is provided diagonally sheathed timber shear walls for lateral support. The roof diaphragm is presumed to be constructed with diagonal sheathing. Likewise, the floor diaphragms are presumed to be diagonally sheathed and are topped with finished wood flooring.

## **EVALUATION STATEMENTS**

The evaluation statements discussed below were found to be false.

Load Path. There are no apparent load collector elements tying the horizontal forces collected by the horizontal diaphragms and distributing these forces to the shear walls. A collector element is a strut that spans the depth of a diaphragm that accumulates seismic loads and transfers these loads to the supporting shear walls. The collector elements are critical as they preclude the possibility diaphragm failure alongside the shear wall.

### **FEMA 178 APPENDIX C EVALUATION C4.2**

#### **Existing Unreinforced Masonry**

Mortar. Masonry joints were evaluated on 06/21/01 per the procedure outlined in Section 5.9 and found to be in generally good condition. In lieu of material tests, default values of shear strength of URM components was taken as 27 psi per FEMA 273, Section 7.3.2.4.

#### **C7 Evaluation**

Minimum Design Forces. Seismic shear was calculated based on the formula:  $V = A_s W$ , with  $A_s = 0.2$ . Wood

Diaphragms. Strength and stiffness of roof and floor diaphragms were found to be acceptable. Collectors. See Load Path evaluation statement above.

Crosswalls. One crosswall exists at Line B. This wall was found to possess adequate shear capacity. Shear

Walls (in-plane loading). All URM shear walls were found to possess adequate shear capacity.

Shear Walls (out-of-plane loading). The stability of all URM shear walls for out-of-plane loading was found to be acceptable.

Shear Wall Anchorage. Although some existing out-of plane anchorages were observed on portions of the pre-1936 construction and minimal joist anchors were specified for the 1936 construction, spacing requirements do meet the requirements of the FEMA 178 provisions.

Sheathed Shear Walls. The diagonally sheathed wood shear wall on Line 1 was found to possess adequate shear capacity. The diagonally sheathed wood shear wall on Line A was found to be deficient in shear capacity.

Veneer. Destructive investigation of the veneer anchor ties was not performed.