



**DUNN ASSOCIATES, INC**  
Consulting Structural Engineers

January 3, 2017

**Bountiful City**  
**790 South 100 East**  
**Bountiful, Utah 84010**

Attn: **Lloyd Cheney**

RE: **STOKER SCHOOL**  
**STRUCTURAL EXECUTIVE SUMMARY**

### Introduction

Previously, an extensive three phase evaluation of the existing Stoker School was initiated by Bountiful City. The purpose of the evaluation was to determine the needs and inadequacies of the building from many aspects, including architectural, mechanical, electrical, and structural. This evaluation was to be performed by a team of consultants and in three phases. This was done so that the owner could elect to continue the evaluation or terminate it depending on the information and results of each phase. The first phase of the evaluation was completed and a report provided. The structural portion of the report was section 3.5, Structural Assessment. During the second phase of the evaluation, however, the evaluation efforts were terminated, at least in part, due to poor in-plane shear testing results on the existing masonry.

Dunn Associates was the structural consultant on the original evaluation team. Bountiful City has requested that we prepare this Structural Executive Summary to clarify the testing performed, the structural impact(s) it has on the building, and how the recommendations in the first phase of the project are affected.

### Phase I

The structural portion of the original Phase I evaluation addressed both gravity and lateral load analysis. The lateral analysis was based on ASCE 31 and ASCE 41 standards. (They two standards have since been combined into a single standard, all within ASCE 41). It used the "Basic Safety Objective" (BSO) as defined in that standard and considers both "Life Safety" and "Collapse Prevention" performance levels. A three-tiered analysis procedure is provided in ASCE 31. Tier 1 analysis was completed in the Phase I portion of the evaluation. Tier 2 analysis was to be performed during the Phase II portion of the evaluation.



Tier 1 analysis determined a variety of structural concerns with the building. These were itemized in the Phase 1 report. Issues dealing with possible change of occupancy and increased live loads, and converting attic to floor space were also explored.

The major lateral issue for the building was the unreinforced masonry shear walls. In-plane and out-of-plane strength of the walls was considered. Seven strengthening methods were discussed along with their advantages and disadvantages. Two were eliminated for architectural disadvantages. The remaining five were combined to provide four strengthening methods for both in-plane and out-of-plane forces. They are as follows:

1. Center core the walls and provide reinforcing. (Method 1.)
2. Brace the walls with vertical stiff back elements and repoint the interior wythe of the masonry walls. (Method 2 and 3.)
3. Brace the walls with vertical stiff back elements and shotcrete one face of the wall. (Method 2 and 4.)
4. Brace the walls with vertical stiff back elements and reinforce one face of the wall with glass or carbon fibers. (Method 2 and 5.)

#### Phase II

Tier 2 analysis required in-plane shear testing of the mortar in the masonry walls to determine the available shear strength in the walls. This testing was performed by American Testing. Tests were performed in numerous places throughout the building, in the various additions and in the various stories of the building. ASCE 31 mandates that the minimum effective shear strength derived from these tests must be equal to or greater than a lower limit of 30 psi in order to be included in the lateral strength of the building. Higher strengths are required where analysis indicates that a higher strength is needed.

The testing requirements include a minimum number of tests per wall and overall. They also require 80% of the tests to exceed the final effective shear value obtained. The values obtained were as follows:

Area	Level	Number of tests	vte(effective shear value)
Gym	Main	6	51 psi
Original Building	Main	5	19 psi
South Addition	Main	12	20psi



Area	Level	Number of tests	vte(effective shear value)
South Addition	Upper	12	20 psi
North Addition	Main	1	Not enough tests

The Gymnasium Addition walls met the minimum limit, however, the north and south walls are still inadequate with the 51psi value obtained. The Original Building walls and the South Addition walls did not even meet the minimum limit of 30 psi and must be repointed and retested in order to be considered as part of the lateral resisting elements of the building. The north building did not have enough tests to determine an effective shear value.

On the exterior walls the testing was only performed on the interior wythe of the walls. It is common for the center wythe of multi-wythe walls to be built with even poorer materials than the interior wythe. At best, it may be assumed that the same mortar was used for each wythe and the testing would be representative of each wythe. It is clear from the testing data that the shear capacity of the walls is very low. Because of the low strengths, instead of just repointing the interior wythe, all three wythes of the walls will need to be repointed. The center wythe is not easily accessible. The interior wythe would need to be removed in order to reach the center wythe. Upon completion of the repointing, the walls would then need to be retested to determine their new in-plane shear strength.

It is recommended that prior to any re-pointing, that the required shear strengths for each section of wall be determined so that the feasibility of obtaining the required strengths can be assessed before the time and expense of repointing is performed. Walls with numerous openings may not have sufficient pier lengths remaining to reasonably be expected to meet the demand.

Upon repointing and retesting, the wall would still be unreinforced masonry and would need to be braced with vertical stiff back elements to resist the out -of-plane forces.

### Conclusions

As previously reported in the Phase I report, there are numerous options available as part of any rehabilitation effort for the Stoker School. Three progressive levels of strengthening were proposed:



Option 1 – Minimum Improvements: Fixing maintenance items and those items deemed dangerous would be prudent and allow continued use of the building. However, this option would preclude any change of occupancy.

Option 2 - Selected Improvements: This option could also be considered. Selected improvements could be made to increase the seismic safety of the building. This option would not include strengthening the existing masonry walls.

Option 3 – Complete Improvements: The anticipated costs for this option continue to escalate, becoming less and less attractive. The cost/benefit ratio is really high. The only reason to consider this option may be if the building has a great deal of historical significance.

Option 4 - An option not presented in the original Phase 1 report, but that could have merit, would be to remove and replace the existing building. This option would allow great flexibility in design without being restricted by the existing conditions.

We hope this executive summary will prove useful to Bountiful City as they continue to make decisions regarding the future use of the Stoker School.

Respectfully yours,

DUNN ASSOCIATES, INC.

A handwritten signature in black ink, appearing to read "David R. Smith". The signature is fluid and cursive, with a long, sweeping underline that extends to the right.

David R. Smith, S.E.  
Associate