KEY SCIENTIFIC TEST RESULTS

A significant number of testing programmes have been carried out on many issues crucial to understanding the strengths and limitations of straw bale walls. The majority of these tests have been done on a small scale, with minimal funding, and we would all benefit from follow-up tests. Between the test results garnered to date and the examples of many historic and well-aged bale buildings, we know a great deal about how these walls work, and how and when they fail.

Included below are excerpts from some of the more informative tests. These are included to sketch an outline of the acceptable parameters of straw bale walls, but they are no replacement for reading the en tire test documents themselves, which we encourage yon to do, using the bibliography at the end of this booklet.

Structural Testing

Structural testing carried out by a number of different laboratories in several countries have all determined that straw bales function as Structural fibre insulation in a stress-skin panel, created by the application of a plaster finish directly to the bales on the inside and outside of the walls. Understanding the principle of the stress-skin panel is key to designing and building a sound bale structure, and applying the lessons learned in stressing the walls to failure is the aim of all the details in this booklet. The most significant Structural testing results garnered to date are given below.

Compression/Vertical Load Test Resalis

Compression testing of plastered bale walls at the University of Colorado at Boulder in 1999 showed the following average results for 8-foot-high and 12-foot-long bale walls without wire mesh reinforcement in the plaster ski as:

	38,867 pounds ultimate strength
	3,239 pounds per lineal foot
three strinq bales	73,877 pounds ultimate strength .
	6,156 pounds per lineal foot
two strinq bales	

In summarising the results of the test, the authors noted that several factors *resulted in a stucco quality lower than will generally be encountered in the field, rendering these results conservative.* These values can be used as a conservative guideline to determine the load-bearing capacity of a straw bale wall system without any internal or external framing system.

The Building Research Centre at the University of New South Wales conducted tests on two-string bale walls according to ASTM £72 standards, stating that *in both the racking tests carried out, the 10 kN (2,248 lb/ft) horizontal load at the top corner produced small deflections of slightly more than 2mm. The material's performance under racking load would be considered acceptable.*

Results
d Load
t Result

The University of New South Wales used the vertical chamber method specified in ASTM £72 to test the walls to a maximum wind speed equivalent of 58 m/s (130 mph) stating that *the maximum static air pressure 0/2.$ kPa (0.4 lb/ in^2) that was applied represents a significant wind of over 6 om/s. Both walls tested showed small deflections of around 7 mm (1/4"). The walls would be considered acceptable jar Structural behaviour under wind load.*

These results show that load-bearing straw bale walls offer enough strength in every direction to meft equivalency requiiements when compared to traditional stud framing. The most important lesson learned in diese tests is that the majority of any loads applied to che bale wali are handlcd by che plaster skin. Thcrefore, it is imperative thar both the interior and exterior plaster skins be posídoned in such a way that roof loads are received into the plaster skins, and that the skins transíer the load to the foundation. A1J top plates and Foundation details in this booklet attempt to do just this, as should any variations adapted by designers or builders.

Inter/mriiiinns of Structural Tests fe»- Detailing

Load-bearing straw walls have been successFully built to heights of 3.35 m (n[1]) and uninterrupced lengths oFz3 m (75'). They have been used to support trusses with a clear span oF 12.8 m (41'). These Figures suggest that load-bearing walls can Function adequately in most residential con-struction scenarios.

Key to the popularity oF straw bale building is the insulative qualities oFthe wall system. While test result figures For the R-value oF a bale wall vary wildly, experience has shown that, regardless oFaay given figures, a well built bale wall exceeds the common standards For insulative valué, placing bale walls in the super-insulated *category.*

Insularíve Valué Testing

Several tests have been undertaken to establish the insulative valué oF a straw bale wall. The results have varied, but the testing perFormed For the Canadian Society oFAgricultural Engineering was carried out on an existing bale building, reflecting real world valúes. The results stated that the R-value, in FPS units, varíete from 30 to 40. The R-value ofthe straw bale walls is in the range ofsuper efficient homes. More testing needs to be done to acquire more definitive valúes.

Figures in other laboratory tests have ranged From R-z6 to R-52. More important than the actual R-value is the need to ensure that bale walls are Free rrom gross air leakage on the inside and outside. All the details in this booklet attempt to minimise or eliminate potential air leakage into the wall.

SHB Agrá, Inc., conducted a small scale Pire test according to ASTM £-119 standards which stated that the plastered bale panel was tested for over two hours and withstood temperatura that reached 104.2 °F. The temperature rise on the unheatedside ofthe test panel, after 2 hours, averagedless than ro°F, with the highest being 21 °F. It is clear from these results that fire resistivity is a potential benefit, rather than a problem for straw bale wall systems.

/•/«• Testing

While fire is oFten the fbremost concern For those new to bale building, the walls actually repre-sent a temarkably Fire-resistant system, with burn times that meet or exceed commercial Fire ratings.

The most comprehensive tests oFmoisture levéis and resultant straw condition were completed by Rob Jolly For the Canadá Mortgage and Housing Corporation. The test included the monitorrng oFnine different buildings over a two year período. He concluded that straw bale walls do not exhibit any unique propensity for moisture retention. It tí clear that straw bale walls can fitnction, without incorpo-rating an interior vapour barrier, in nonhern climates that receive mild to modérate amounts of precipitation. In comparison to standard frame construction, straw bale walls generally incorpórate higher perm (more breathable) interior and exterior protective layen. Combined with the hygroscopic nature of straw, these factors aUowfor a highly dynamic wall system. Within limits, a straw bale wall has the capacity to adl absorb moisture, and diffuse this moisture to either the exterior or interior ofa structure. However, this capacity should not be used as an excuse for inappropriate designs or applications.

Moisture Testing