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***Waste Today, Wall Tomorrow:
Assessment of an Innovative Straw
Block for Residential Construction***

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Introduction

The availability of environmentally friendly building materials is on the rise. Environmentally conscious consumers and builders have begun creating a market for alternative building products, and a proliferation of products has ensued. Acceptance of new products in both the green and mainstream building markets depends on a number of factors, especially consumer demand and builder perceptions of consumer preferences. We explore these factors for one new green building product, a compressed straw block.

Research Questions

We examined the potential market acceptance of the CP Block, a new and innovative building block made of highly compressed rice straw. Oryzatech, the manufacturer of the Block, plans to introduce this product to the residential housing market as a substitute for conventional wood frame construction. We explored both the potential consumer demand and building industry acceptance prior to its market entry by answering the following questions:

- 1. How does the CP Block compare to other building materials?**
- 2. What motivates homebuyers to purchase a straw block home?**
- 3. What motivates builders to adopt the block as a construction material?**

Significance

The use of a rapidly renewable material such as straw in the building industry could lead to many benefits for both homeowners and society. Straw, an agricultural byproduct, has historically been treated as waste. Most states allow farmers to dispose of straw by burning but in California this practice has been banned for over a decade. Hence, there exists a need in the state to find other uses for nearly a



million tons of rice straw per year. Fortunately, straw is well-suited to be a building material.

Buildings constructed with the CP Block would provide private benefits such as energy efficiency to owners, and public benefits such as the reduction of energy demand and air pollution.

Background

The National Association of Homebuilders (NAHB) reports the number of new homes being built has risen sharply in the past few years, from 1.6 million in 2000 to 2 million in 2005 (NAHB 2006). A nationwide survey conducted by NAHB shows that builders are reporting shortages of conventional building materials. As a result, rising wholesale prices of building materials have added over \$5000 to the cost of building an average new home, and construction delays caused by supply shortages could translate into further cost increases (NAHB 2004). The increase in the current demand for residential housing coupled with changing prices for conventional building materials present a growth opportunity for alternative building materials and methods.

As an alternative wall construction material, the CP Block possesses both private and public benefits. Two



Benefits to Homeowner
 Increased energy savings
 Improved indoor air quality
 Better soundproofing
 Increased fire resistance

private benefits of building with rice straw are the near-absence of toxic chemicals in the material, leading to better indoor air quality, and the reduction in

energy costs due to the superior insulating characteristics of the wall system. The decrease in energy demand is also a public benefit because of a decrease in the negative externalities associated with energy production: air pollution, noise generated by power plants, and consumption of non-renewable resources such as natural gas or coal. In addition, because the CP Block will be a substitute for conventional wood frame houses, fewer trees will be harvested for residential home construction.

Benefits to Environment
 Reduced energy demand
 Improved air quality
 Improved soil fertility
 Reduced waste
 Saved trees

Rice straw is an agricultural waste product that has brought major environmental and social concerns to California's Sacramento

Valley. Traditionally, the two main options for rice straw removal have been either incineration or incorporation into the soil. Unfortunately, rice straw incineration leads to increased levels of air pollution. In 1991, California passed the Rice Straw Burning Reduction Act to phase down the practice. As a result, farmers had to till the rice straw back into the soil which added costs and reduced crop yields. With over 1.2 million tons of rice straw generated every year (CRC 2005), the CP Block is being introduced as a solution to both the problem of rice straw removal and the need for alternative building materials.

side by side along factors such as price, physical dimensions, energy efficiency, durability, and product availability. The product comparison can be a valuable tool for owner-builders and developers who are interested in using green and alternative materials in the projects they build.



PRODUCT COMPARISON					
Note: Please see individual spec sheets for detailed information on labor and construction					
	CP BLOCK*	2X4 STUDS	2X6 STUDS	CONCRETE MASONRY UNIT (CMU)	INSULATED CONCRETE FORM (ICF)
U.S. Code acceptance	No	Yes	Yes	Yes	No**
Average cost/ft ²	\$4	\$0.5-\$2	\$2-\$5	\$3	\$1-\$4
Wall thickness	13"	5"	7"	8"	variable
R-value	24	11-18	15-18	17.5	7-26
Product Availability	-	+	+	+	0
Durability	+	0	0	+	+
Breathability	+	-	-	-	-
Energy efficiency	+	0	0	+	+

KEY:
 - low 0 moderate + high * predicted for CP block ** see

Figure 1. Excerpt from the product comparison

Methodology

1. How does the CP Block compare to other materials?

We conducted a product comparison of the CP Block with ten conventional and alternative building materials used in the residential construction market. We produced individual specification sheets for each material describing product characteristics such as construction methods and environmental impacts. In addition, we created a table comparing the materials

2. What motivates homebuyers to purchase a straw block home?

Our primary goal was to estimate consumer demand for CP Block housing. While doing this we also wanted to explore how potential homebuyers would perceive a CP Block house. Since a CP Block house provides both public and private benefits, what portion of the willingness to pay (WTP) would come from the public environmental benefits? We were also interested in the effect that branding would have on the CP Block: would identifying the block as straw

WTP



lower demand? In order to answer these questions, we developed a contingent valuation survey for the CP Block. Survey respondents were asked to choose between a conventional wood frame home and a CP Block home.

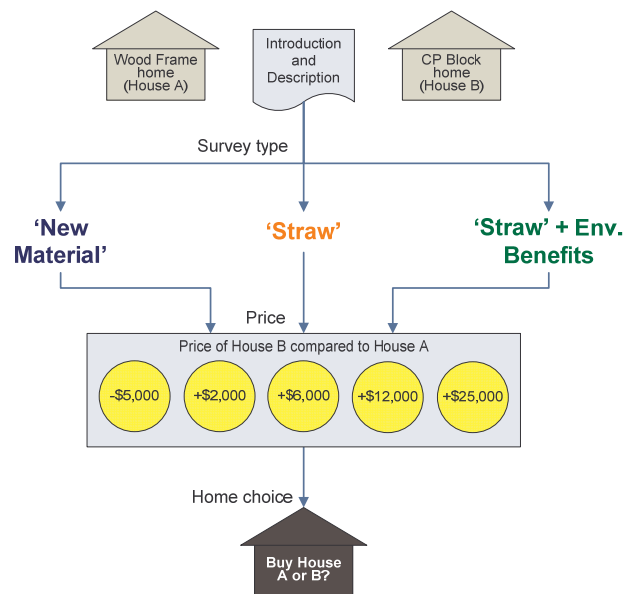


Figure 2. Consumer survey flow chart

The survey had several variations to which the respondents were randomly assigned. In order to construct a demand curve, the price difference between the two homes was systematically varied across the surveys. To answer our question about WTP for environmental goods, some surveys included an additional section which detailed the public environmental benefits of owning a straw block home. Finally, in order to investigate the effect of describing the material as straw, some surveys merely identified the home as being built out of blocks which were a “new building material” rather than specifying they were made from “highly compressed rice straw.” We conducted a nationwide survey and obtained a US Census representative sample of 1,024 responses.

3. What motivates builders to adopt the block as a construction material?

Although consumer demand is an important factor in determining a potential market, homebuyers do not typically build the homes they live in; they generally purchase a home already built. Builders make most of the decisions about which materials to build with, so

we sought to understand builders’ perception of the block as an option for housing construction and their likelihood to adopt the block.

To understand industry perceptions, a separate survey was developed to assess the perceptions of building professionals. We asked respondents to estimate the percentage of new home buyers in their area who would purchase a straw block home rather than a conventional home based on a range of prices. The industry responses could be used to construct an industry-estimated demand curve for straw block housing, which could be compared to the demand curve derived from the consumer demand model.

The survey also asked builders whether they were likely to adopt the straw block for their own projects, and to evaluate what factors they considered important when deciding to adopt a new building material. From these responses we attempted to explain the factors that were significant to builders in choosing to adopt the straw block.

Analysis and Results

Results Summary

- **Consumer demand:** Significant potential
- **Environment:** Homebuyers are willing to pay more for public benefits
- **Branding:** Fewer respondents want to buy homes when they know it is made from straw
- **Industry perceptions:** A lower demand predicted by the building industry
- **Industry acceptance:** Builders may adopt if there are buyers and the block is easy to use

We used the results from our surveys with US Census data to construct a set of demand curves, depicted in Figure 3. Our results predict a relatively large potential market for the CP Block: at a \$15,000 price premium, approximately 10-40% of new home buyers would choose the CP Block home when informed about both the public and private benefits. The demand curves are downward sloping; for each \$1000 increase in the CP Block house, about 1% fewer buyers would choose it.

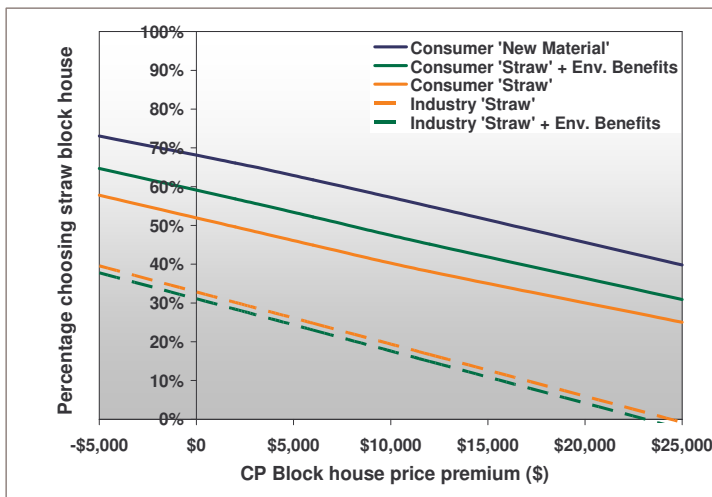


Figure 3. Demand curves

Consumer survey

The different versions of the consumer survey provided additional information about homebuyers' preferences. On average, respondents were willing to pay an additional \$6,200 for the public environmental benefits of owning a straw block house. There was also a large effect from branding the block as "straw." Respondents who knew the block was straw were willing to pay far less, about \$14,500 on average, for a CP Block house compared to those who were only informed it was a "new building material." These differences are reflected in the three upper lines on the graph in Figure 3.

Industry survey

Building professionals estimated much lower demand for CP Block housing, as seen in Figure 3 (dashed lines). The industry-estimated percentage of straw block home buyers was about 25-30 percentage points lower at a given price than the demand from the consumer survey. The large gap between the industry's predictions and consumers' own responses can partly be explained by consumer yea-saying, which is the tendency for survey respondents to say they would purchase a CP Block home when in actuality they would not. We expect, therefore, that actual demand is below the consumer survey curves, and that the industry demand curve may be closer to reality.

When asked about adopting the CP Block, industry professionals revealed that the two most important factors in their decision were consumer demand and ease of construction. Both effects went in the expected direction: builders with higher estimates of

demand were more likely to adopt the block, as were those who perceived the block would be relatively easier to use for construction. Other significant factors included concerns about flammability and susceptibility to moisture.

Conclusions

Our consumer survey analysis was combined with Census and new housing starts data for the Southwest US to generate projected hotspots in demand for CP Block housing. As seen on the map, these are centered in the major population centers in the Southwest, including the Sacramento area in Northern California, which is the region where the majority of California rice is grown.

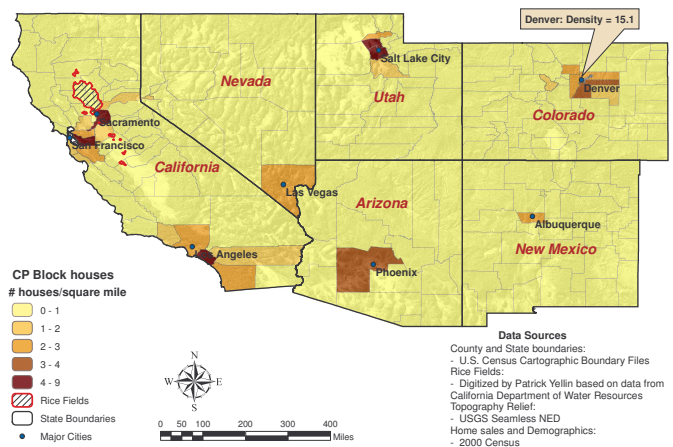


Figure 4. Projected density of CP Block homes

Our results suggest that there may be a large potential market for the CP Block, but that market size is sensitive to perceptions of a straw building material. Environmentally conscious consumers who are willing to pay more for products with environmental benefits will likely form a portion of the CP Block market. Our study of the building industry suggests that acceptance from builders will depend on convincing them the CP Block is relatively easy to construct with and that there is viable demand from homebuyers.

References

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