EXPANDING OSB STRUCTURAL PANEL MARKETS BY ENHANCING DURABILITY

John D. Lowood, P.ENG, SBA President, Structural Board Association

Introduction

History of OSB

Oriented strand board or OSB is the second generation of waferboard. Waferboard was developed by Dr. James d'Arcy Clarke of the Potlatch Corporation in 1954 who was looking for a way of using the wood species in Potlatch forests which were not suitable for lumber and pulp. Dr. Clarke discovered that by slicing the freshly harvested logs along the grain that these slices or "wafers" could be bound together with a phenolic based resin and pressed into a panel which had many of the characteristics of plywood. Potlatch constructed a small mill in Minnesota and sold the product locally.

In 1961, a group of businessmen in Saskatchewan, Canada, purchased Dr. Clarke's patent and built a mill on the edge of Canada's boreal forest in eastern Saskatchewan in the town of Hudson Bay. (It is 600 miles southwest of the ocean called Hudson Bay). The group had serious financial problems and in 1963, the mill was taken over by the Saskatchewan provincial government and sold to MacMillan Bloedel Ltd.(MB), a large forest products company with headquarters in Vancouver, B.C. MacMillan Bloedel successfully restarted the mill which contained one 12 opening 1.2m x 4.8m press and forming line. The press, dryers, blenders and forming line were modified particleboard equipment, while the waferizer was a large horizontal chipper which sliced rather than chipped the 0.6m log blocks. MB was able to market the product trade named "Aspenite" in central Canada for roof, wall and floor sheathing, fences, barns, cattle sheds, grain bins, garages packaging and hoarding. The marketing was successful because Aspenite was priced much below plywood. Many of these early "Aspenite" buildings constructed in the 1960s are still being used today.

In the 1970s, a number of other mills were constructed in Canada and the first mills built in the U.S.

Canada

1973 - Malette, Timmins, Ontario
1974 - Weldwood, Longlac, Ontario
1974 - MacMillan, Thunder Bay, ON
1975- Great Lakes Paper
1978 - Northwood,Chatham, NB
1981 - Normick, LaSarre, Quebec
1981 - Grant Forest, Englehart, ON

United States

1972 - Blandin Paper, Grand Rapids, MN
1976 - Temple Inland, Claremount, NH
1980 - Georgia Pacific, Woodland, Maine
1980 - Georgia Pacific, Dudley, NC

Standards Development and Building Code Acceptance

During the 1960s and through most of the 1970s, approval to use waferboard on residential buildings was by each company applying to the local building official to allow the contractor to use the product. Manufacturing companies were members of the U.S. National Particleboard Association (NPA) and waferboard was called a type of particleboard. In 1976, the Canadian industry formed the Waferboard Association to work on standards and with the assistance of NPA, the first waferboard standard was developed to cover the US market, ANSI A 208.1-2MW Mat Formed Exterior Grade Particleboard made from wafers with exterior use binders. This standard was referenced in the four US model codes, the Uniform Building Code, the National Building Code and the Standard Building Code and the CABO One and Two Family Dwelling Code. Certification to ANSI A 208.1 was undertaken by Timberco (TECO) now part of the PFS/TECO Corporation. Similarly in Canada, the Canadian Standards Association Standard CSA O188.2 Mat Formed Waferboard was developed, which expanded the approval of waferboard in Canada as this new standard was referenced in the 1980 Edition of the National Building Code of Canada.

In 1978, the first oriented strand board (OSB) was produced and this was recognized by the American Plywood Association, now APA-The Engineered Wood Association or APA as having equivalent performance to plywood for most similar uses. It was included in APA's performance rated panel standard **APA PRP 108**, followed shortly afterward by **TECO PRP-135** and in 1985, by Canadian Standard **CSA O437 Waferboard and Strandboard.** In 1987, a further standard was developed for performance in Canada, **CSA O325 Construction Sheathing,** which covers both OSB and plywood and closely matches APA PRP-108 and TECO PRP-135.

In 1992, as a requirement of the Canada/US Free Trade Agreement, Canadian and US structural wood panel standards were harmonized and a new **US standard, PS2-92 Wood Based Structural Use Panels** was published by the US Department of Commerce. The development of the harmonized panel standards was a cooperative effort of APA, COFI and SBA, encouraged and supported by the US and Canadian governments. Today OSB manufactured to the harmonized standards CSA O325 Construction Sheathing and DOC PS2-92 Wood-based Structural-use Panels is quality certified by PFS/TECO, PSI and APA.

Today OSB has full building code acceptance in North America. In Japan and Europe the standards are in place, but the product has not yet been fully accepted by all building code officials in Japan. In Europe, the EN Standards must be adopted by the member countries of the EEC. However, mills are now obtaining individual country approval.

Engineering Design with OSB in North America

The initial OSB design information for the US came from APA's Technical Note TN375 which is a document providing engineering design values for plywood and modification factors for OSB which are applied to the plywood values to obtain the OSB values. This document was first published in 1988 and updated in 1993. In 1988, the Structural Board Association commenced work on an OSB engineering design standard for Canada. A full testing program was carried resulting in a series of strength levels or classes, which would allow a manufacturer to have a design rated product to suit his level of technology. This standard is identified as CSA O452 Design Rated OSB. To qualify as "design rated" mill panels must meet a 95% percentile strength and stiffness level when tested at 20°C and 80% relative humidity. Design Rated OSB is now incorporated in the Canadian

Engineering Standard CSA O86.1 Engineering Design in Wood which currently allows it for use where humidity levels do not produce wood moisture contents higher than 15%. Like plywood, design values are further modified for duration of load and long term performance. In the US, design values are being established for OSB separate from plywood and will be published in a joint CAN/USA Supplement to the ASCE Specification for Wood Engineering.

North American Production and Markets

Since the early 1980s, the production of OSB has expanded rapidly in both the U.S. and Canada, although in Canada, with the exception of the Pelican mills owned by AL Owens, waferboard was still the dominant product until the late 1980s. The faster growth in the U.S. was due to mills being built close to large growing communities, overall lower cost and OSB's general better performance than southern yellow pine plywood. In 1993, U.S. mills produced approximately 7.5 million m^3 and Canada produced 2.5 million m^3. These volumes are changing rapidly and by 1997, the U.S. will produce 11 million m^3 and Canada, 6.0 million m^3. It is expected that at least 15% of this volume will be exported offshore. (See Figures 1 to 3 on OSB supply and demand)

Canadian Mills

Ainsworth Lumber Co. Ltd. (2 op); Group Forex (3 op); Grant Forest Product Corp. (1 op); Louisiana Pacific Canada Ltd. (2 op); MacMillan Bloedel Ltd. (3 op); Malette Inc. (2 op); Norbord Industries Inc. (2op); Slocan Forest Products Ltd. (1 op); Tolko Industries Ltd. (1 op) Voyageur Panel Limited (1 op); Longlac Wood Industries Inc. (1 op) Weyerhaeuser Canada Ltd. (3 op) **Total Number of Mills 22**

U.S. Mills

Georgia Pacific Corp. (6 op); International Paper Inc. (3 op) J. M. Huber Corporation (4 op); Langboard Corp. (1 op) Louisiana Pacific Corp. (14 op) Northwood Panelboard Company (2 op); Oregon Strandboard (1 op); Potlatch Corp. (3 op); Martin Lumber Company (1 op); Weyerhaeuser Company (3 op); Willamette (1 op). **Total Number of Mills - 39**

Outside North America

Poland (1 op); Ireland (1 op) Scotland (1 op); France (1 op); Luxembourg (1 op).

Legend: op. operating
uc. under construction

OSB has grown rapidly in popularity since 1980, encouraged by its equivalency to plywood, its simple life cycle and its respect for the environment.

Offshore opportunities for OSB

In September 1994, the international Swedish forest products consulting company Jaakko Pöyry gave a presentation on the world wide use of panel products to the SBA Annual Meeting. There report indicated an annual increase in the demand for wood based panels at 3% per year and engineered wood panels such as MDF and OSB at 5% per year. Specifically, OSB would grow at 5.7% per year and MDF at 10.5% per year, with Asia/Oceania's growth for OSB to 1.5 million m^3 by the year 2000. Similar growth was forecast for the European/Mediterranean area, however this market would be satisfied in part by European production and North American producers would be required to manufacture a slightly different product to meet European standards for construction uses. According to Jaako Pöyry, this growth opportunity will happen because, these products have moderate raw material costs, improving cost competitiveness compared to solid wood products, strong and expanding markets, and a wide range of end uses.

Uses for OSB

OSB can be used for almost all the uses of both particleboard and plywood. The reader is cautioned that OSB will expand when it is directly exposed to heavy rain or high humidity over long periods, unless it is specifically engineered for this end use. Therefore, it should only be used in protected construction or interior use. However, as OSB is an engineered product it can be designed by the manufacturer for all practical end uses and the manufacturer will do this provided there is a sustainable market. In the initial stages of market development, SBA recommends that importers form groups of potential users to work with one or two manufacturers to take advantage of volume development and lower costs.

Remember, OSB can be engineered meet a great number of different specifications.

- In North America, OSB has 56% of the Residential Sheathing market for roofs, walls and floors.
- In the Industrial market, OSB is used packaging,
- crating, furniture frames, industrial counter tops,
- shelving, wire spools, bins for chemicals, paint and food, slave pallets, door styles and most applications were wood panels are required.
- In the construction market, OSB is used for hoarding, platforms, safety guards, hidden forms
- stair treads.
- In agriculture, it has been used for 30 years for grain bins and animal housing.
- In manufactured housing, it is used for wall, roof and floor sheathing, truss gussets and ridge beams.
- As engineered wood, OSB is the I-joist web, the rim-board (joist) and the face of structural insulated panels.
- Stained or painted, it serves decorative uses as floor tile, wall panelling and display cases.

Research on OSB

During 1990 and 1991, the OSB industry suffered badly with prices falling to barely cover variable production costs. A number of temporary closures occurred. The upturn in building activity in the first quarter 1992 with improving prices quickly opened mills and brought North American production back to pre-recession volumes.

Table 1 Tomorrow's Opportunities

- OSB has 23% of the residential flooring market. This market has the greatest potential for growth in North America.

- OSB has only very limited use as a concrete form work panel. There is a huge demand in South East Asia for an economical (compared to luaun plywood) form panel.

- Like most wood products, OSB is not used for homes in semitropical and tropical countries. There is a huge demand for housing in these countries.

- OSB has proven attractive as a siding product, but it lacks durability performance.

- Sanded and stained OSB is attractive to architects and designers but fire performance needs improvement before there is acceptance in Canadian public buildings.

- Increased use in engineered design with improved long-term load performance under high humidity.

At the same time, remembering 1991, the industry represented by the Structural Board Association realized that strong measures were required to build OSB's popularity and further its market share to avoid a repeat of 1991. In the Association's opinion, a strong market driven research program was the best way to make this happen. So an alliance was formed in 1992 with the Alberta Research Council and Forintek Canada Corp., two of Canada's largest wood research organizations, to carry out engineered wood research. The research program annually worth over $1.4 Million is managed by SBA and now involves three major research organizations and nine universities in Canada and the US. In addition to industry funding, major support for this program is being provided by the Alberta Government, Forestry Canada and Industry Canada.

The program of research covers projects initiated by market need and projects initiated by operations.The program has not only carried out significant research but has encouraged the OSB industry's major suppliers and equipment manufacturers to upgrade their products. Changes in press size is one example, presses have increased from 1.2m by 4.8m to 3.6m by 7.2m.

An important requirement for the expansion of OSB market penetration is the need for improved durability. OSB is a wood product and free water or prolonged high humidity impacts its performance. Because OSB is manufactured from hardwood, and because the manufacturing process incorporates high stresses into the strands, Sheathing grade OSB reacts to free water and high humidity faster than traditional wood building products. In the short term and during normal construction delays, because OSB uses waterproof and boil proof binders, free water and high humidity have no impact on structural integrity, strength performance or fastener holding ability. However, if this exposure continues for long periods, and there is no chance of dry out, these three properties are affected. This exposure over time will produce, surface delamination, mold growth, laminar separation of strands, sponginess and rot.

Meeting the Challenge

A number of initiatives have been created in order to meet the challenges posed in the search for enhnaced durability of OSB. These include:

The Forintek/ARC Composite program on directed by SBA-

- the addition of borates
- stabilizing with Steam Pressing
- thickness Swell Reduction
- surface Enhancement

University Research directed by SBA on:

- addition of borates
- variability
- panel swell

Manufacturers have:

- technologically advanced processes
- statistical Process Control
- carried out independent research

Progress by the OSB Industry

The recent industry expansion has included the installation of technically advanced computer controlled manufacturing equipment in the new mills. The design and implementation of a specific recipe for the end product is now much easier. SBA Manufacturers have developed or are in the process of developing :

- New edge coatings
- Enhanced surface coatings for both fire and durability improvement.
- New floor panels that exceed plywood performance.
- Borate treated panels
- "Combi" panels
- Enhanced siding products

Performance and Standards

North American panel standards focus on bond durability. Bond Durability is usually measured under conditions of vacuum pressure soak. Can be a single or multiple cycle test. Other tests concern thickness swell:

- 24 hr soak
- 14day, one sided wetting
- vacuum pressure soak (i-joist webs)

European OSB Standard EN 300 requires specific durability performance for Type 4 OSB panels which are required for structural use under high humidity conditions. The recently completed Long term performance of OSB study will provide guidance to manufacturers to improve durability as it affects creep and DOL.

Market Access and Development

In 1994, the Structural Board Association together with the Canadian Particleboard Association and the Canadian Hardwood Plywood Association, formed a federal corporation, the Wood Panel Bureau (WPB). This was formed for the purpose of increasing the world-wide knowledge of Canadian produced oriented strand board, particleboard and medium density fibreboard and hardwood veneer and plywood. It has the objective of opening new markets and expanding existing markets. The WPB program includes development of technical bulletins and manuals in Japanese and other languages, direct mail campaigns to potential users, advertising, videos, product analysis, market access work, missions and special training. This is a tripartite program funded by Industry, the Federal Government and the Provinces of Alberta, Ontario and Quebec. The annual budget is approximately $1.1 million dollars and the objective is to increase export volumes by 15 percent. It will include education on the promotion of OSB as an engineered structural panel.

Marketing OSB as a Panel of Choice

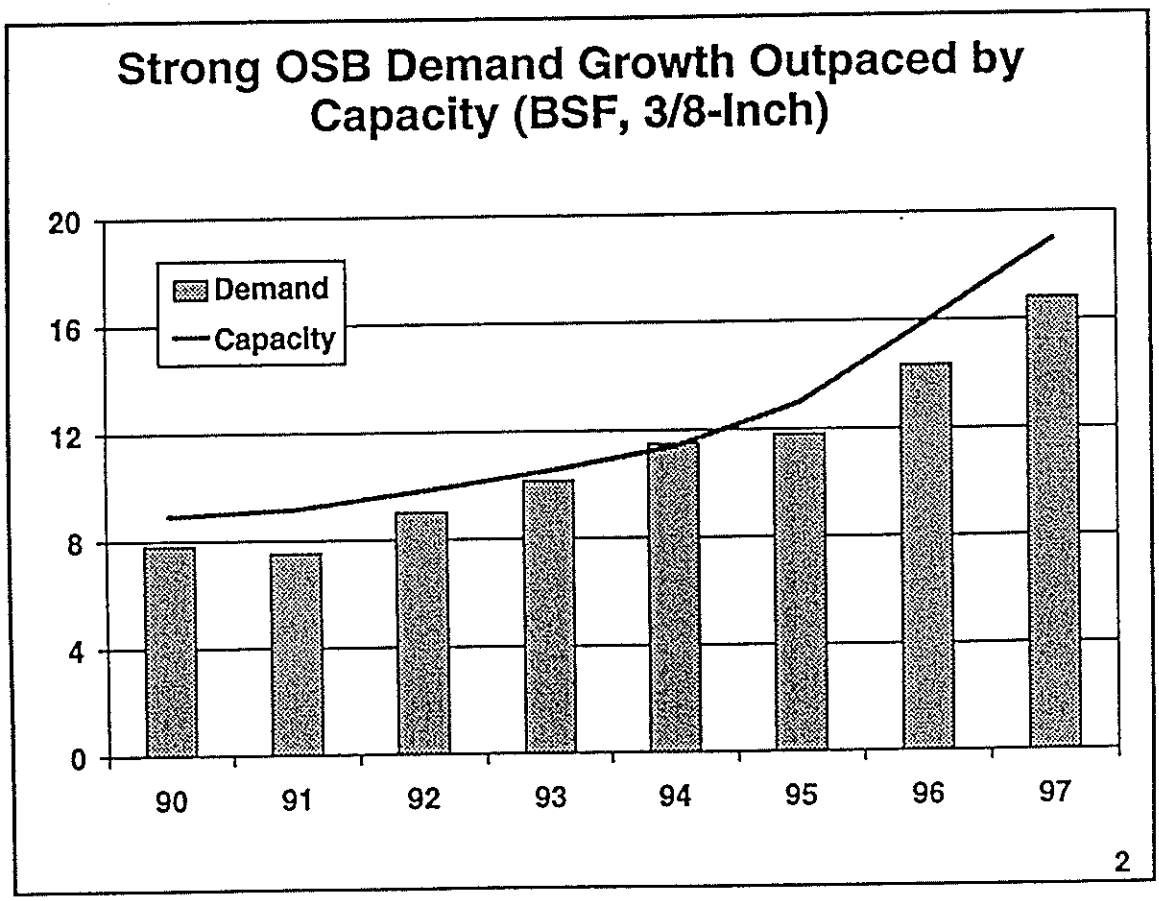
OSB is a unique product that is often confused with particleboard or chipboard by those people who wish to protect the use of plywood. The significant difference is that OSB is a structural panel that uses a boil proof and water proof binder to bind the strands together. It is also a multi-layer panel which has the surface strands aligned or orientated in the long panel direction. As it is made from lower cost logs in highly automated plants it is less costly to produce than plywood even though it uses the same type of resin binders as exterior grade plywood.

Conclusion

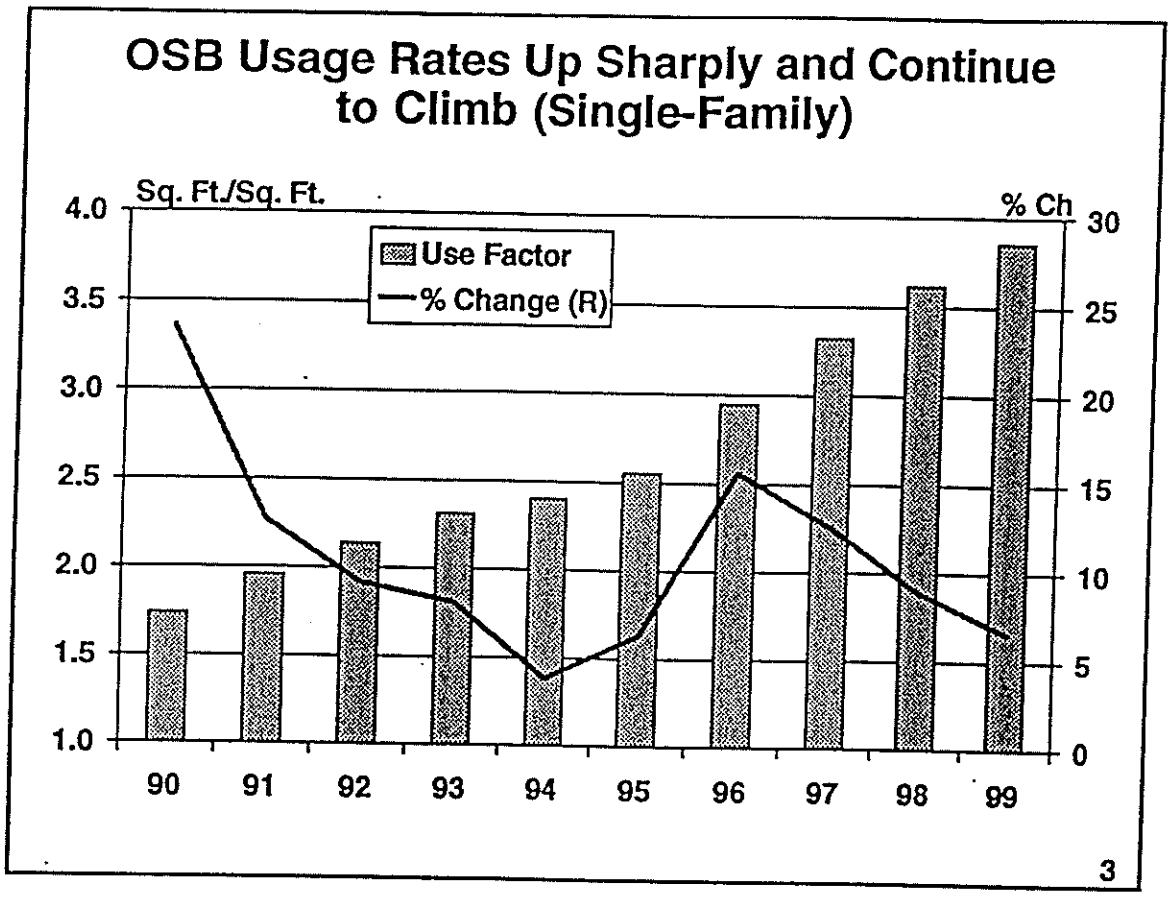
The major capacity expansion has forced OSB manufacturers to examine the commodity sheathing product and its potential to satisfy the capacity growth.

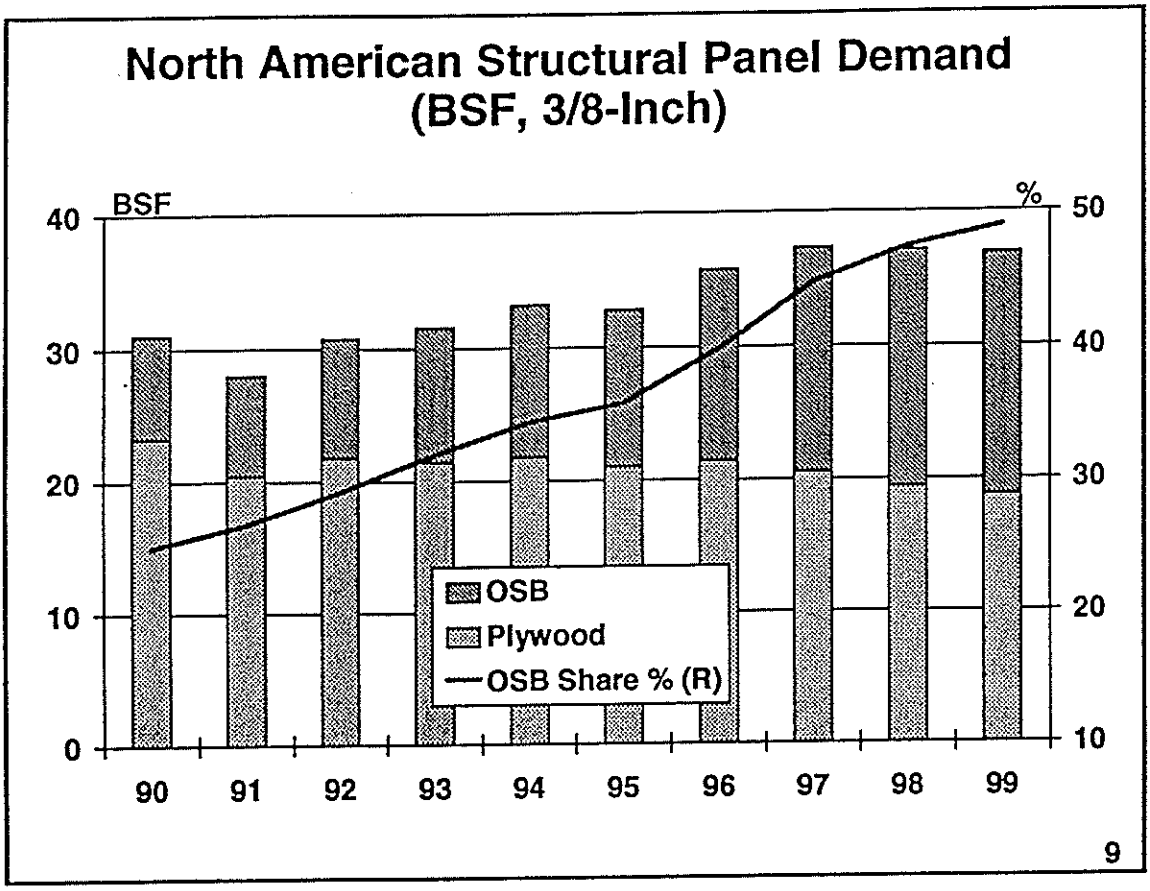
Realizing that this was not going to be possible, SBA members have embarked on an unprecedented product development program backed by the SBA Technical Program to have products available which will meet or excede the performance of competative products in the market place.

Enhanced durability has a key role in this work.



Resource Information Systems, Inc.


OSB Usage Rates Up Sharply and Continue to Climb (Single-Family)
Sq. Ft./Sq. Ft.
% Ch
4.0
3.5
3.0
2.5
2.0
1.5
1.0
30
25
20
15
10
5
0
Use Factor
% Change (R)
90
91
92
93
94
95
96
97
98
99
3


North American Structural Panel Demand
(BSF, 3/8-Inch)
BSF
%
40
30
20
10
0
50
40
30
20
10
OSB
Plywood
OSB Share % (R)
90
91
92
93
94
95
96
97
98
99
9