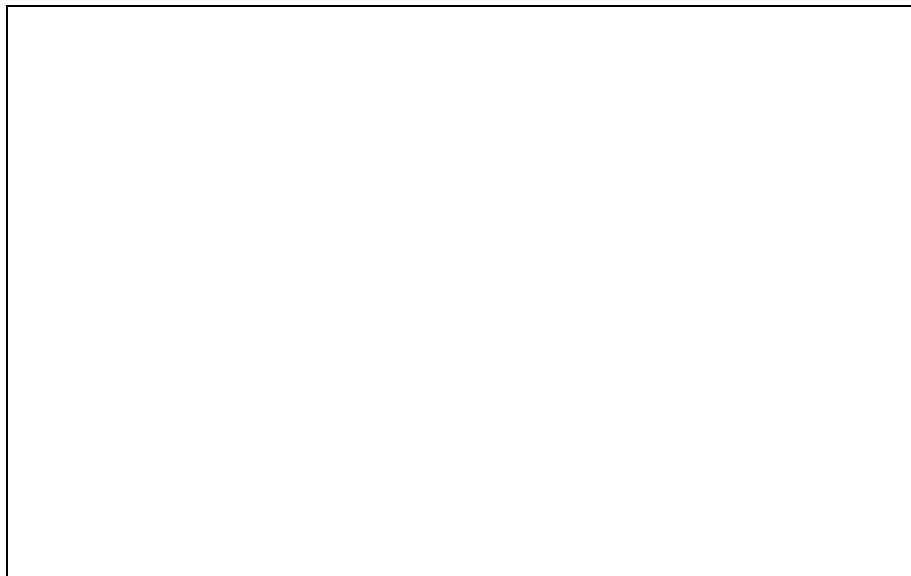


Lower Costs Through Waste Reduction

Practical Ideas for Ontario Home Builders



by **Habitat Associates**

for the **Ontario Home Builders' Association**

September 1997

The Ontario Home Builders' Association believes that waste reduction is an important objective in the house building process.

In our research, we came to two conclusions. First, reduction is by far the most economical of the 3Rs. This is demonstrated through examples of builders who have increased profits through integrated waste reduction techniques. Second, builders' waste quantities and management techniques vary widely. Therefore, builders can learn a lot from each other about practical ways to minimize waste.

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Focus on Waste Reduction

Focus on Waste Reduction

Purpose of this Document

The Ontario Home Builders' Association represents builders large and small, in major cities and smaller communities, each with their own unique requirements. In order to help all of you progress towards waste reduction, we recognized that a homegrown, grassroots approach was needed. We felt that the best way to demonstrate the benefits of waste reduction was to provide home builders with examples of how waste reduction improves the bottom line.

As a result, we developed two guides. "Lower Costs Through Waste Reduction: Practical Ideas for Ontario Home Builders" documents some of the benefits of being waste-wise. It offers a number of strategies for addressing waste that other builders have proven effective.

We have also developed a kit for local home builders' associations on how to organize an event focussing on waste reduction. That document is intended to assist local HBAs with bringing together local expertise and experience to raise awareness about the positive aspects of reducing waste. If you don't hear about an upcoming event, you might contact your HBA to let them know that there is interest out there. Hopefully this will encourage them to hold a workshop, an on-site demonstration, or a meeting on lowering construction costs through waste reduction.

Focus on Waste Reduction

10 Reasons to Reduce Waste

Reduction is by far the best way to cut waste and its costs. Here's why:

Cost - Reducing waste saves money by lowering both *disposal* costs and the amount of materials *purchased*. Disposal costs average 5% of the profit of a home, but vary considerablyⁱ. Efficient framing techniques alone can reduce material costs by \$1,000 or more per home.ⁱⁱ

Efficiency - Efficient use of materials reduces time spent handling waste and the number of trips the disposal company makes to the site.

Safety - Tidy job sites are safer job sites. A site that produces less waste is easier to keep clean and clear of debris.

Productivity - Better quality work tends to occur on a clean site. Less time is spent moving materials around and walking around obstacles. It also takes less time to build a house designed to use materials efficiently.

Conservation - Wasting good material just doesn't make sense — using only what we need and keeping usable resources out of landfill does. Often people do care about the environment, but do not know about reliable alternative techniques that curb waste.

New Products - New products or techniques that cut waste are continuously being developed. While many of these, such as trusses or re-usable forms, are not specifically designed to reduce waste, they can significantly reduce waste in addition to their principal function.

Professional Development - Material-saving techniques that save money while reducing waste are less well known than they could be. Many construction practices are learned on the job and done one way because of tradition — they've always been done that way — without the benefit of advanced products and techniques, and under false perceptions of what building codes require.

Preparedness - If home builders as an industry voluntarily take steps to reduce waste, governments will be less likely to impose legislated targets. As landfills fill up, municipalities are putting bans on certain construction wastes, so it makes sense to understand and explore alternatives to disposal *before* additional impediments/regulations are imposed.

Distinction - By actively diverting waste from landfill, home builders and renovators can become distinguished leaders in the community.

Marketing - Many builders, home buyers, and communities favour environmentally responsible practices. Distinction in the marketplace can lead to positive press and a competitive edge that enhances customer relations and improves home sales.

What About the 3Rs?

This document is focused on **reduction** as opposed to reuse or recycling, for many reasons.

Not generating waste in the first place saves money not just at the disposal stage but also at the materials purchase stage. It also reduces natural resource depletion and lessens stress on the landfills, which saves us all money in the long run.

Where it is not possible to reduce waste, consideration should next be given to reuse. Many reuse techniques are already being practised, from using cutoffs from framing lumber for bridging, to using excess insulation for soundproofing.

Recycling construction waste on the job site is time consuming and expensive compared to reduction. Major wastes generated by construction, like wood and drywall, don't have as high a value as commonly recycled materials like metals. Furthermore, recycling markets can be distant (adding to cost) and volatile (subject to fluctuating prices and uncertain supply and demand). This is not to say that you should avoid recycling, but consider it a last resort, after implementing reuse and especially reduction strategies.

So, when you think about the 3Rs, think of avoiding waste altogether. Think 1.

REDUCE

2. REDUCE

3. Reduce

Focus on Waste Reduction

How to Use this Document

This document contains materials to assist you with understanding the facts about waste, the real costs, and the misconceptions. These materials include:

- relevant facts and figures, including cost, effort and time requirements
- reduction tools and techniques
- anecdotes and testimonies from builders
- a list of resources for additional information

Feel free to adapt the information to suit your own needs. Pick and choose whatever makes sense to you or fits into your operation. If you need more information about specific techniques, encourage your local home builders' association to track it down, because if you have concerns or questions, you can bet others do too. Your home builders' association has the tools to bring together the appropriate people to address the issue.

Finally, if you have experiences addressing waste that you think we should know about, please contact us. Whether your experience is good or bad, help us keep this material up to date, so that we can deliver the most accurate and useful information possible, and, as an industry, stay ahead in the game.

Dispose of the Misconceptions

There are many misconceptions about the cost and convenience of waste reduction. To help dispell these misconceptions, we have focused on waste reduction techniques that are known to work.

Some builders already practice many of the waste reduction techniques outlined here. However, by nature the home builder learns on the job. Because techniques are handed down by tradition, many techniques common to some builders are new to others.

It is worthwhile asking your trades which techniques they have tried or heard about, and rejected. Get the details. Often new ideas fail for peripheral reasons: a new technique was not fully or genuinely considered, the wrong tools were used, or the intent was misunderstood. There may be more knowledge in your operation than you realize, and sharing experience serves everyone. Invitations encourag-ing 2-way communication and teamwork usually pay off.

Residential Construction Waste

In response to rising landfill costs and loss of landfill space in the early 1990's, the construction industry in Ontario recognized the importance of reducing its contribution to the waste stream. One of the initiatives undertaken at that time was the Toronto Home Builders' Association's *Making a Molehill Out of a Mountain*. This landmark study was one of the first to document construction waste composition (see below).

Average Quantities of Residential Construction Wastes

Reprinted with permission from the Greater Toronto Home Builders' Association


Another initiative was Canada Mortgage and Housing Corporation's *Residential Waste Management Challenge* workshops, given nationwide in 1991. A survey of builders who took the workshop generated some very revealing information about expected versus actual costs (see page 7 for details).

In January 1993, the Ontario construction industry released a voluntary 3Rs Code of Practice. This involved the Ontario Home Builders' Association and many other construction and trade associations.

In the early 1990's, the province of Ontario struck a C&D Waste Reduction Strategy Team, which was to identify practical ways to achieve, for the construction and demolition sectors, the target of decreasing the amount of waste by at least 50% by the year 2000 compared to 1987. In 1994, the province created legislation affecting waste management in many industries, including construction. Builders constructing more than 2,000 m² of floor area are now required to develop waste management plans. As of July 1996, the province is reviewing details of the legislation.

In 1997, TerraChoice and Ortech International are re-vitalizing the Build Green Program. It will expand beyond supporting recycled building products, to a much wider mandate relating to all aspects of green construction, and including all phases of the building life cycle.

Waste Management at a Glance

Options		Description	Advantages	Disadvantages
Waste Reduction Through Efficient Framing		<ul style="list-style-type: none"> •Design: using modular dimensions, detailed framing & sheathing plan •Construction: in-line framing, stud/joist spacing > 16", header sizing, reusing lumber cut-offs, etc. 	<ul style="list-style-type: none"> •Significant savings in framing material purchased and wood disposal costs 	<ul style="list-style-type: none"> •Can require architect, building inspector, framer involvement •"Cost-cutting" perception
Waste Reduction Through Contract Structure		<ul style="list-style-type: none"> •Requires subcontractors to dispose of their own waste •Can include a cleanup policy limiting the time and location of waste on site 	<ul style="list-style-type: none"> •Potential disposal savings •Promotes efficient use of materials •Improves appearance of site (no large containers) 	<ul style="list-style-type: none"> •No guarantee of material recovery •Requires written contract & recommended legal review
Waste Recycling (Increasing level of builder involvement) 	Jobsite Clean-up Service	<ul style="list-style-type: none"> •Subcontractors place all waste in designated area/ container, hauler handles the rest 	<ul style="list-style-type: none"> •Little to no builder involvement •Costs established up front •Smaller container or no container on site •No jobsite separation, which lessens drive-by contamination 	<ul style="list-style-type: none"> •Invisible system — does not promote waste reduction •Not yet widely available
	Co-mingled Recovery	<ul style="list-style-type: none"> •Separation of commingled waste and recovery of recyclables off-site; materials contained on-site in conventional manner 	<ul style="list-style-type: none"> •Builder not required to separate wastes by type •Less potential for drive-by contamination 	<ul style="list-style-type: none"> •Invisible system — does not promote waste reduction •Not available everywhere
	Jobsite Separation	<ul style="list-style-type: none"> •Subcontractors place waste and recyclable materials in separate containers 	<ul style="list-style-type: none"> •Highly visible system •May be available from conventional haulers 	<ul style="list-style-type: none"> •More containers on site •Requires compliance of subcontractors to control contamination •Discouraged by some haulers
	Self-Haul	<ul style="list-style-type: none"> •Builder handles, transports and tips all materials 	<ul style="list-style-type: none"> •Creates opportunity for reuse on site 	<ul style="list-style-type: none"> •Material must be stockpiled •Requires time, knowledge of recycling outlets •Substantial vehicle wear and tear
Other Ideas	Wood/Gypsum Land Application	<ul style="list-style-type: none"> •Chipped, uncontaminated wood in mulch or compost •Pulverized clean drywall used as soil amendment or in compost 	<ul style="list-style-type: none"> •Potential to handle waste locally or on site •Chippers readily available and affordable to rent 	<ul style="list-style-type: none"> •Province discourages unauthorized land application of waste •Low-value use of scrap •May be more expensive than traditional recycling
	Take-back policies (e.g. carpet padding, carpet, vinyl, drywall)	<ul style="list-style-type: none"> •Waste returned to place of purchase or manufacture for recycling into new product 	<ul style="list-style-type: none"> •Individual trade/sub assumes responsibility for single waste material •Cuts down on separation and transportation costs 	<ul style="list-style-type: none"> •May only be available to large-volume customers •Suitable only for uncontaminated and high value materials

This table based on NAHB Research Center's "A Builder's Field Guide" (1997)

Facts and Figures

Edmonton's Residential Waste Management Audit

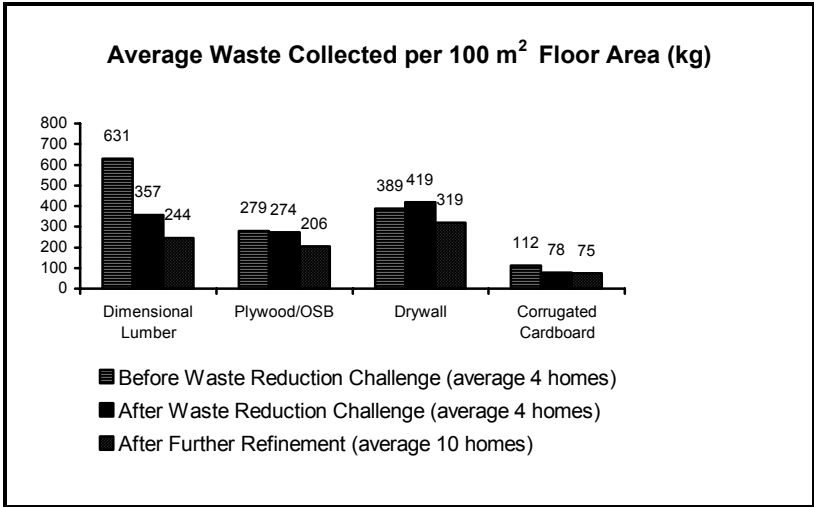
Known as *Partners in Clean Construction* (PICC UP), the Greater Edmonton Home Builders' Association (GEHBA), the City of Edmonton, Canada Mortgage and Housing Corporation and several local builders joined forces in 1991 to develop viable, pro-active strategies to reduce construction waste. They:

- audited waste generated from several homes before and after initiating new waste management techniques, and again after the industry had an opportunity to refine and develop their techniques.
- developed training materials that were presented to builders and twelve sub-trades.
- published a handbook and made it available to the industry throughout North America

Results are presented in the graph above. This initiative showed that waste can be reduced significantly, and that over time further reductions are possible. Notice that lumber waste was cut by more than half!

Training Manual Available!

A training manual and 13 minute video are available from the Greater Edmonton Home Builders' Association at 403-425-1020. The manual contains pull-out sheets, one for each of the trades. The cost for this package, including G.S.T. and postage, is \$18.60.



CMHC's Residential Construction Waste Management Challenge

In 1991, CMHC hosted thirty-two 3-hour interactive workshops for builders nationwide. The purpose of the workshops was to:

- raise awareness of the landfill crisis and to provide practical alternatives
- demonstrate the federal government's commitment to the environment
- promote the 3Rs and encourage the building industry to participate
- transfer design and technical knowledge to the industry
- position CMHC as a leader, catalyst and partner in solving environmental issues related to housing.

Two years after the workshops, a follow-up survey was conducted to determine whether builders were still practicing waste minimization and how it had affected their business. The follow-up survey found that:

- 73% of those workshop participants who agreed to commit to implementing waste management practices on a current or upcoming project did so
- 88% of those who undertook recycling activities maintained them
- only 24% reported having difficulty finding a recycler who would accept reusable material once it had been separated from non-recoverable waste; 63% did not have difficulty
- **13% had increased cost, 38% had little or no effect on their bottom line, and 17% saved money** (five respondents specified savings per house: \$20, \$25, \$75 and two \$100 per house).
- job sites were reported as safer
- 25% reported incurring significant capital costs, e.g. signage; 63% did not
- 71% reported saving money on tipping fees since implementing recycling
- 50% reported that waste management activities did NOT incur additional labour costs; 37% reported incurring additional labour costs
- 75% said recycling did NOT add significantly to the time required to complete a construction job; 17% found it did
- 92% felt their efforts to recycle were worthwhile
- 63% reported their workers felt efforts to recycle were worthwhile

The results show that enhanced waste management practices are neither as difficult nor as expensive in terms of time, labour or capital costs as builders initially thought

Feelings immediately after the thirty-two workshops

Immediately after the thirty-two workshops, the following data were gathered through a questionnaire:

- over 60% implemented a Waste Management Action Plan
- 56% altered building designs to make them more efficient
- 78% improved material storage procedures
- 89% improved their material procurement procedures
- 90% found uses for excess materials in other parts of building projects
- **60% believed that managing construction wastes would increase costs in the short run**
- 100% believed that managing construction wastes would save money in the long run
- 64% felt there were insufficient recycling businesses to handle their construction wastes.

Waste Reduction Tips

General Waste Reduction

Significant waste reduction is rarely the result of any single effort or activity, but rather the combination of many individual efforts. This section may give you some ideas that can be applied in your operation. The first two pages provide general waste reduction tips. Subsequent pages focus on specific wastes and waste reduction techniques.

Set Goals

Waste reduction goals (e.g. reduce tipping fees by 20%) have to be clear to all key participants, including draftspeople, subcontractors, superintendents and labourers. Encourage input from everyone. Practical waste reduction methods are often developed on-site through trial and error, so try to be open about approach while firm about the goal.

Monitor Costs and Waste Production

Consider monitoring clean up and waste disposal costs. Most builders have never costed out their *full* waste disposal expenditures, including subcontractor disposal fees, labour, and equipment maintenance, fuel and insurance costs, and there is a tendency to underestimate them. What about the cost of buying the materials that eventually get thrown out? Ask your subcontractors how much they charge for waste disposal. You might be surprised at your total waste costs.

Look for Obvious Opportunities First

Look for double-handling of materials, and try to consolidate steps.

Stand-alone operations (framing, drywalling, carpeting) are good candidates for material separation. If you use your own labourers or a hired clean-up service, you may be able to schedule clean-up to take advantage of this. If subcontractors remove their own waste, you might want to show some interest in where the waste goes. If you use detailed tender and contract documents that specify how wastes will be handled, check that the subcontractors adhere to them.

Communication

Clear communication is important to any job or process, and waste reduction is no exception. Make sure that you talk to everyone involved, and explain both your goals and the rationale behind them. Explain the methods that you would like to try, and encourage your workers to provide you with feedback and suggestions for further improvement.

If you are practicing at-source separation, clear signage should indicate what *does* belong in the bin and what *does not*. It doesn't take much to contaminate a dedicated load.

M.J. was curious about where exactly waste was being produced on his job sites. He believed that until you know what you've got, you can't do anything about it. Though he believed that minimizing waste was the right thing to do, he felt that a closer look at waste types and quantities would suggest ways to improve.

He enlisted his waste hauler, who began to keep detailed records and to look for alternative destinations for the larger waste materials, especially wood. Chipped wood was sold to a variety of new customers, e.g. to landscapers as mulch, to farmers as animal bedding, and to a mill for composite board manufacture.

At the end of the one-year experiment, 51% of materials previously going to landfill were diverted to other uses, and M.J. saved \$4,160 in tipping fees that first year. Now, he pays only for the lift, because the sale of recyclable materials is equivalent to tipping fees.

On the jobsite, everybody has become a lot more conscious, and there tends to be less scrap. On top of everything, both the builder and the hauler got lots of good press, and the positive exposure was good for both businesses.

Waste Reduction Tips

General Waste Reduction

Nurture Good Relationships

Waste reduction requires the cooperation of many people. *Significant* reduction requires coordination from the designer all the way through to the labourer. Tips for dealing with specific groups follow.

Trades: Recognize that you are asking people to change their ways. Old habits die hard and, contrary to the opinion of those who have them, the tried and true is not necessarily the best way. Tradespeople need ongoing and consistent explanations about why it is in their interest to change. It is easier for them to put the extra effort in when they see that the builder is not merely interested in cutting costs; builders have received cooperation by explaining the logical and environmental costs of excessive waste. Informal discussions with individuals can establish mutual understanding, recognize initiative, and provide reinforcement.

Subcontractors: Getting cooperation from subcontractors can be tricky. If you are the first one to ask for waste reduction practices that exceed the norm, you may have your work cut out for you. While contracts can be used to specify where and how subcontractors dispose of waste, it is better to get voluntary cooperation; emphasize how *they* benefit by reducing scrap. Ultimately, it would be easier if all builders required a standard level of service, which is one reason for builders to meet to discuss strategies. Remember, the alternative might be that government agencies will impose their standards one day.

Haulers: In choosing and dealing with waste haulers, ask them where their waste goes and ask to be kept informed of new developments. This will let the hauler know that you care, and while they won't likely change their practices overnight, when faced with two equivalent options they might go with the most environmentally-friendly alternative if they know it makes a difference to their clients.

Suppliers: If you see opportunities for improvement, why not talk to your supplier? They may know of unique opportunities, like pilot projects to return clean scrap or packaging to manufacturers by backhauling, which eliminates transportation costs. This has been done for vinyl siding in Michigan, and is being tested in Ontario for scrap plastic. In Minnesota, a manufacturer reduced packaging waste at the builder's request.

Designers: Designers play a major role in material savings. Using 2-foot multiples, specifying alternative stud spacing, and accurate estimating are key to reducing waste *and* saving on materials purchased. To fully use the designer's capability to minimize materials use and waste, the site supervisor and crew will have to be trained and/or need detailed layout and framing instructions. In the beginning you may need to work closely with on-site personnel; the transition may be awkward and you'll need to distinguish growing pains from changes that really don't make sense. Like everyone else, designers can only do what they're being asked to do, so communicate your intentions and reasons clearly.

N.R. bought into the concept of efficient framing. He saved more than \$1,000 per home in dimensional lumber by moving from 16" centres to 19 3/8" centres on non-loadbearing walls. Modifying roof and floor trusses has saved as much as \$1,200 on a 2,800 sq. ft. home. Wood waste has been reduced by 50 to 60%.

"There's a tremendous resistance out there. The best way to get the framers to cooperate was not to threaten them, but to educate them. For example, in framing 60 houses, 50 trees would be saved by being a little more careful. Appealing to their sense of decency and the impact of their actions works because a lot of people care but don't know what to do.

"It's a matter of education. Framers need to understand *why* they're being asked to do something. If they think all you want to do is make more money, they won't bother. They need to understand that more houses will be built if wood isn't wasted, that *they* will build more houses if the company builds more efficiently. If what they care about is money, you have to go from there.

"Change has to come from the top. The designer does only what he's told to do. These ideas have to be bred into people. Talk in the guys' language." He is in continuous contact with framers about where to save, and doesn't hesitate to reward them for coming up with new ideas.

3 Principles: Design, Precision, Tools

Many techniques exist to reduce construction waste. These reduce not only the amount of waste needing disposal, but also the amount of materials purchased in the first place, so they can provide an important economic incentive for addressing waste.

Many builders are not using available waste-reducing techniques. There are several reasons for this:

- Because many construction techniques are learned on the job, many builders are not aware of alternative methods that are more efficient.
- There are misconceptions about what building codes require.
- There is a belief that home buyers regard houses built with less material as inferior.

This document discusses all of these limitations, mainly by presenting several examples of reliable alternatives to conventional techniques.

Essentially, there are three ways to significantly reduce construction waste:

1. carefully designing buildings to improve the efficiency of materials used
2. precise materials ordering and accurate timing of delivery
3. use of pre-cut, custom manufactured and engineered products, and advanced framing techniques (e.g. 2-stud corners, 24-inch centres, etc.)

These 3 methods are expanded on the following pages.

Did you Know?

Waste disposal costs represent about 5% of the average profit on a home. That's not counting the purchase cost of all those unnecessary materials!

Many builders use the stud-per-foot rule of thumb for estimating studs. A 1996 waste audit of a Maryland builder who used this approach revealed that about 15% (by weight) of the 2x4s and structural sheathing ended up in the dumpster.

From NAHB Research Center's "A Builder's Field Guide" (1997)

Waste Reduction Tips

Design

Start at the Beginning

Cut/fill calculations reduce double handling of material and wasted machine time.

The amount of concrete required for footings can be significantly reduced through careful excavation.

Building Design

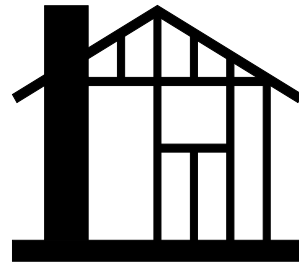
Minor variations in the floor plan can save lumber and other dimensional materials that require cutting (e.g. drywall, insulation, carpeting). Dimensional material and sheet goods that need cutting are the largest contributors to the waste stream. By designing in multiples of standard material sizes (i.e. 8' or 12' modules that correspond to material dimensions), you can minimize off cuts. You should be able to modify your designs efficiently with the help of architectural software and/or your supplier. It can be a balancing act, but careful designing and estimating, either done manually or with appropriate software, can minimize overall waste.

Additional waste reduction can be achieved when wall dimensions and window/door locations take into consideration standard brick bond and coursing to minimize cutting waste.

Carefully designing services can reduce the amount of materials that you have to purchase. For example, plumbing services can be located close together and close to the building service entry. Locate electrical panels close to area of greatest need (kitchen) to reduce wire runs.

Conducting a waste audit has helped builders identify their waste quantities and composition, enabling them to target specific materials. The inset on page 8 describes one builder's experience that began with an audit and ended with positive economic results and good press.

N.R. eliminated a beam worth \$75 by moving a wall one foot.



Wood is the single largest waste material generated on construction sites. Up to 10% of all lumber purchased for construction becomes waste!ⁱⁱⁱ Wood waste also has the greatest potential for reduction (see page 6), and there are many ways to reduce wood waste by good planning and design (see pages 14 to 16).

Waste Reduction Tips

Precision with Materials

Precise materials estimating and careful handling can significantly affect the amount of waste created.

- Order only what you need and in suitable sizes.
- To prevent inappropriate use of materials, put the responsibility for obtaining and paying for improperly used material replacements on your crew. This has been proven to generate impressive results.
- Tell tradespeople which materials are intended for which component of the job (i.e. which materials are intended for joists, beams, etc.) This takes only a little more time, and is a worthwhile investment.
- Have materials sent to the site in stages. Less material will be lost to weathering, improper storage and theft. This also reduces the temptation to cut larger pieces for unintended uses (e.g. pieces intended for the roof being cut for the floor).
- Consider stacking material on site in the order in which it will be used.
- Inspect materials on delivery for defects, and immediately return oversupplied or damaged goods.
- Look for suppliers who offer a credit for returned unused materials.
- Favour suppliers who will retrieve their material packaging.
- Minimize exposure of materials to the weather, and store above grade level. Improper material storage can lead to huge losses, so be sure to know if this is a problem and consider investing in tarps, proper storage space, or timely material delivery systems. Timely deliveries can be coordinated through your designer and supplier.
- Secure your material piles at the end of each day. This will reduce theft and create a safer, more efficient workplace.
- Allow for less waste during take-offs (e.g. 10% reduced to 5%).
- Keep track of unused building materials, so you can adjust future orders to reduce waste the next time the plan is built.

F.B.'s framers get just the right amount of wood delivered to the site each day, maybe even slightly less. If the wood is not efficiently used, the framer has to go back to the stock area for more. They know they'll be back-charged if there's excessive waste. This approach encourages "measure twice, cut once" (or is that "think twice, curse once"?)

"The best way to save is to run a tight operation." This means knowing how much material is needed at each stage of the project, and keeping "lots of eyes" on the trades.

N.R. found that lumber yards consistently over-estimate lumber requirements. Now they do all their own estimating, which alone saves \$600 to \$700 per home in purchase cost, not counting avoided disposal costs.

Advanced Tools: Materials Selection

Pre-cut or Custom Manufactured Materials

Pre-cut or custom manufactured materials save on waste, and can be extremely cost-effective, especially after taking labour into consideration. Not only is less waste produced on the construction site, but factory-built components can reuse smaller pieces of wood, use fast growing tree species, and end up providing more strength than dimensional lumber. These include trusses, I-beam floor joists, and wall systems.

Some builders are concerned that home buyers think engineered wood products and material-saving framing techniques, such as those discussed on pages 14 and 15, make an inferior home. Home buyers need to understand why material-saving practices are better than dated ones, so try explaining why, for example, an extra top plate is not needed (see page 14). Explain that their home not only complies with building codes, but meets the highest standards of quality, and is engineered for maximum strength, longevity and durability. They might need to hear that professional builders' associations have been promoting these techniques for years, and they are proven reliable. You are the expert. Assure them that more wood does not make a better house, but only depletes forests unnecessarily, produces excessive waste, and increases costs.

Perhaps your product representative can provide you with factual information in an appropriate brochure format that you can pass on to prospective home buyers. For example, the brochure at the back of this document explains the significant cost and waste savings as a result of using wood trusses and wall panels.

Bulk materials that don't need to be trimmed, like blown cellulose insulation, can radically reduce waste.

One year in the off-season, A.D. held weekly meetings with his whole crew, from designers through to the labourers. After some initial suspicion, people recognized a sincere interest in their input and having things run more efficiently.

At the end of that year, a 1% savings appeared on the balance sheets. Labourers had more respect for materials. Most important, a team spirit led to many improvements:

#1 proper design: designing bearing points to optimize the use of lumber by moving a wall a few inches saved \$300 to \$400 per house. "People have a tendency to oversize things, and have a lot of misconceptions about the building code."

#2 accurate ordering and delivery in phases: with just enough wood on site to do the floor, there's no temptation to cut long pieces meant for the roof. A 1/4 hour meeting each morning with the framing carpenter explaining what goes where avoids costly mistakes that have to be ripped out and extra trips to the lumber yard.

#3 correcting orders: there's always room for improvement. Before materials go out, the site supervisor provides an inventory of materials left over from the previous day. Quantities for the next delivery are reduced by that amount, and the material list is modified for the next time the plan is built.

Now, there's tremendous communication and cooperation, and constant improvement. The crew meets twice a year. About \$200 is saved on disposal alone, and including materials, a conservative estimate puts typical savings at about \$500 to \$600 per home.

Wood: Advanced Framing Techniques

Reducing Framing Waste

Framing lumber is one of the largest material purchases and the largest component of the waste stream. Efforts to reduce framing waste are most effective if addressed during several phases, including design, estimating and framing. This means that the most effective reductions will involve your architect, your estimator, your supplier and your framing crew.

Although the most significant savings can be achieved by using a combination of advanced framing techniques, individual techniques can be used and are worth trying.

The following techniques are recommended:

- **House Configuration** — House plans with overall dimensions on a 2-foot module permit optimum use of floor and wall materials.
- **In-Line Framing** — Aligning framing members such as trusses, studs and joists to bear directly over each other is the most efficient way to transfer loads from the roof to the foundation.
- **Increased Spacing of Joists and Studs** — Increasing stud spacing of interior and exterior walls (i.e. from 16" to 19.2" or 24") can reduce the amount of framing material by up to 30%.
- **Roof Design** — Modest changes to either the pitch of the roof or the width of the overhang can reduce the amount of material required and the amount of waste generated. Page 16 contains information that provides the optimum range of eave widths for efficient roof design.
- **Engineered Products** — Roof and floor trusses saves a lot of waste compared to site-built systems. Bowing and cupping is minimized because wood is kiln-dried.
- **Single Top Plates** — Use of in-line framing, regardless of the spacing of the framing members, allows the use of a single top plate.
- **Corner Details** — The stud/block/stud detail is commonly used for framing many corners. The two-stud/1x backer detail shown below reduces the number of studs required to frame outside corners and intersecting walls.

Profile: Material Savings

Estimating software was used to quantify the material savings of the following value-engineering techniques for a 2,300 sq. ft. home in Pennsylvania.

Technique	Savings ¹	
-In-line framing at 24" o.c.	\$960	at
(Increased floor joist spacing from 16" to 24")	(\$747 ²)	16"
-Reduced header sizes	\$162	
-Relocating 4 doors and windows	\$ 45	
-Ladder framing at intersecting walls	\$ 45	
-Two stud & backer corner framing	\$ 30	

¹ Savings based on lumber prices from mid-Atlantic region in March 1996

² Because the builder typically uses 3/4" floor sheathing, the increased joist spacing did not require thicker floor sheathing.

Note that 78% of the in-line framing cost savings (\$747 of \$960) is due to reduced floor framing costs. In other words, the saving from reduced stud and plate material is much less than from reduced joist material.

From NAHB Research Center's "A Builder's Field Guide" (1997)

Wood: Advanced Framing Techniques

Reducing Framing Waste (continued)

- **Construction Drawings** — Detailed framing layouts for the wall and floor structure permit accurate quantity take-offs. More accurate material estimates can also be generated with detailed layouts that eliminate excessive studs at exterior corners, partition junctions and window/door openings.
- **Over-Designed Lintels** — Lintels over openings can be value-engineered according to header tables included in the building code. Jack studs and lintels can be completely eliminated in non-load bearing walls.
- **Substitute Materials** — Use steel drywall clips instead of extra lumber to support drywall at ceilings and corners.
- **Separation of Reusable Lumber** — Use cut-off 2x wood for bridging, stakes, bracing, shims, drywall nailers, and blocking where interior walls run parallel to joists or trusses. Cutoff sheathing waste can be used for drywall stops and furring.
- **Relocating Doors, Windows and Stairs** — Moving the horizontal position of such openings to coincide with modular studs reduces the number of framing members required to frame a wall or floor. While moving some openings can be limited by a desired aesthetic, furniture layout or mechanical requirements, others can be shifted slightly without adversely affecting the home's form or function.

Conventional Framing

Advanced Framing

Profile: Material Savings

Estimating software was used to quantify the material savings of the following value-engineering techniques for a 2,300 sq. ft. home in Maryland.

Technique	Savings ¹
-Accurate take-off tools	\$595
-Increased floor joist spacing from 12" to 19.2"	\$412 ²
-Modular roof design	\$194
-House configuration (modular over-dimensions)	\$124
-Reduced header sizes	\$ 39

¹ Savings based on lumber prices from mid-Atlantic region in March 1996

² Because the builder typically uses 3/4" floor sheathing, the increased joist spacing did not require thicker floor sheathing

From NAHB Research Center's "A Builder's Field Guide" (1997)

Wood: Advanced Framing Techniques

Value-Engineered Roof Design

Value-engineering principles can be applied to nearly all components of a house. For example, a value-engineered roof has a top chord/rafter dimension on the two-foot module, i.e. 12, 14, 16, 18 and 20 feet in length, to minimize sheathing waste. In addition, the range provided in this table will minimize rafter cutoff. The table assumes a square cut at the rafter end; an adjustment can be made for a plumb cut.

Using these eave widths with the corresponding design conditions results in sheathing cutoffs no greater than 12 inches in width. Although eave dimensions can differ from the front to the back of houses, use of a two-foot module (as opposed to a four-foot module) assumes that a 24-inch-wide strip of sheathing could be used on the other side of the roof.

OPTIMUM RANGE OF EAVE WIDTHS FOR VALUE-ENGINEERED ROOF DESIGN

Storing Drywall Scraps in Vacant Wall Framing Cavities

The OHBA does not endorse storing drywall scraps in vacant framing cavities. The technique is controversial, and does not necessarily reduce the amount of waste generated, though it can reduce the amount needing disposal. Some builders are curious about it, however, and those who are should know that guidelines do exist.

Drywall crews report that the technique requires 2 labour hours for a 2,000 square foot house. Whether the 2 hours spent cutting and filling cavities is more or less than the time and cost associated with conventional disposal depends on the distance between the disposal bin and the house, where the scrap is delivered to, and other factors. Cost-effectiveness may also depend on who is responsible for disposal — cavity storage places responsibility for waste on the drywall subcontractor.

If you want to try this method, the National Association of Home Builders Research Center (U.S.) prepared the Guidelines on the next page. They also suggest considering the following:

- *Disposal savings.* Approximately 80 to 90% of waste can be expediently stored.
- *Liability.* While building codes allow this practice, local building officials may have concerns. Builders need to decide whether permission from or notification of the home buyer is prudent. Finally, builders should verify that the drywall crew fully understands the proper technique.
- *Future remodelling.* The guidelines on the next page are designed to minimize the impact on subsequent remodelling activity, and address concerns that cable/electrical/computer runs are not damaged or difficult to install.
- *Drywall rattling within the cavity.* The guidelines suggest toe-nailing to secure drywall scraps in vacant framing cavities.
- *Impact on dead load.* Given a wallboard density of just under two pounds per square foot for 1/2 inch thick wallboard, even total cavity fill would not require structural modifications.
- *Choice of wall.* Select walls that are over top of load-bearing walls or in the basement, rather than loading up an interior wall, to avoid putting extra weight on the centre floor joists.
- *Sound transmission, fire retardance, and thermal mass.* The contributions of this technique to reduced sound transmission, improved fire retardance, and increased thermal mass are undocumented and probably minimal. Builders should be careful not to overstate these benefits.

One drywall contractor said he produced 1/4 to 1/2 less waste on jobs for which he was responsible for disposal.

A.D. challenged his drywaller to dispose of all drywall scraps in the walls. The drywaller accepted the challenge—and succeeded. Now, having taught himself how to do it and knowing what's practical, the drywaller typically packs away 30-40%, reducing the time and money spent on clean up and disposal.

When deciding on the usefulness of this technique, look for hidden disposal costs in your drywaller's fees or your clean up costs (include labour, equipment, mileage, etc.)

Guidelines for Storing Drywall Scraps in Vacant Wall Framing Cavities

- 1. Use only framing cavities that do not have insulation, wiring, plumbing, or HVAC duct runs.** Do not use exterior framing cavities that require insulation. Do not use interior cavities with plumbing, electrical or HVAC runs, thereby preventing damage to the work of previous trades or eliminating the need for special cuts around such items as outlets or switch boxes (see figure below).
- 2. Identify the vacant cavities before you start.** Second-floor closet, bathroom, bedroom, stairwell, garage, and finished basement vacant framing cavities work well.

3. Consider the order in which walls are hung so that vacant wall cavities remain available. This may require starting another room before the last one is completely hung, but remember the waste must be generated first.

4. There is no need to fill the entire cavity by using precise measurements. Speed is important; approximate and score the scrap to a size less than the width of the cavity. Multiple scores can be used on larger scraps to create an “accordion”-type bundle. In some cases, scraps can be placed to allow double stacking (see figure above).

5. Fill the cavity before hanging the second side of the wall. This allows access to the scraps for proper placement and fastening (steps 6 and 7).

6. Provide adequate clearance for future wiring. Always provide at least 1-1/2 inches of clearance for any future wiring; stacking 4 sheets deep is the maximum for 1/2-inch-thick drywall in a 2x4 stud wall; 8 sheets for a 2x6 stud wall.

7. Prevent movement of drywall. To reduce the possibility of drywall scraps shifting or rattling in a framing cavity, screws or nails can be “toe-nailed” to secure the scraps.

8. Never place anything other than drywall scraps in the framing cavity. This method is for drywall only.

Resources

Videos

Title	Subject	Contact	Cost
Waste Education	all aspects of construction waste	Greater Edmonton Home Builders' Association 403-425-1020	\$18.60 (including G.S.T. and postage)
Framing the American Dream	craftsmanship, ease of use and savings in component vs. stick-framing; side by side footage compares floor, wall and roof systems	Canadian Wood Truss Association 800-463-5091	\$45.00 plus G.S.T.
Making a Molehill Out of a Mountain	learn to reduce, re-use and recycle through proper planning and good construction practices	CMHC 800-668-2642 package no. 4011E	\$13.90 (including G.S.T. and postage)

Internet

C&D Waste Web Site (collects and posts region and waste-specific information, case studies and contacts, links to and from other sites, etc.): www.cdwaste.com

Environmental Building News (provides new product reviews, case studies, in-depth and short articles, book reviews, events, etc. Contacts and telephone numbers are often included): www.ebuild.com ebn@ebuild.com

Documents

Some of the most important documents that were researched and used for this study include:

- City of Edmonton, Public Works Department. Partners in Clean Construction: A Blueprint for Action for the Residential Construction Industry, 1996. (403-425-1020)
- Kalin Associates Inc. The Residential Construction Waste Management Challenge Follow-Up Survey and Report. Ottawa: Canada Mortgage and Housing Corporation, 1994. (800-668-CMHC)
- National Association of Home Builders (U.S.) Research Center. Residential Construction Waste Management: A Builders Field Guide, 1997. (800-898-2842)
- REIC Consulting Ltd., Renova Consultants, RIS Ltd. Making a Molehill out of a Mountain. Toronto Home Builders' Association, 1990. (416-391-3445 or 800-668-CMHC)

Endnotes

ⁱ At \$10,000 profit with \$500 spent on waste disposal, waste disposal costs represent 5 percent of your profit on a home. Actual costs vary from builder to builder and between regions.

ⁱⁱ The National Association of Home Builders Research Center (U.S.) estimates savings of between \$500 and \$1,000 per home through the use of advanced framing techniques. For a breakdown of what each technique saves in lumber costs, see pages 14 and 15.

ⁱⁱⁱ Source: REIC Consulting Ltd., Renova Consultants, RIS Ltd. Making a Molehill out of a Mountain. Toronto Home Builders' Association, 1990.

For more information,

to give us your feedback on this document, or

for the companion Kit on holding a waste reduction event,

please contact

Ontario Home Builders' Association

20 Upjohn Road, North York, Ontario M3B 2V9

1-800-387-0109

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