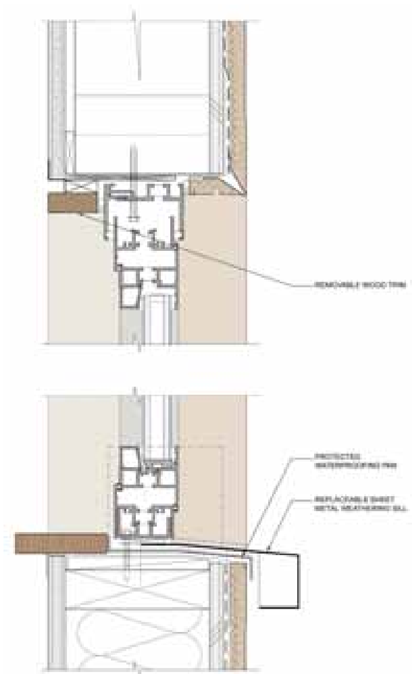
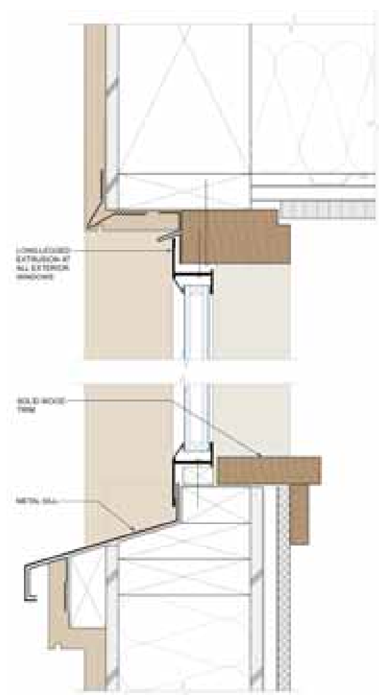
One of the staples of school modernizations is window replacement. In order to ensure a water tight and durable window to wall interface, the window is often buried below the exterior wall finish, cement plaster in this case, either as a nail on flange window, or with the exterior finish butting up against the frame. The interior finish often butts up against the interior of the window frame to provide a finished appearance without requiring interior window trim. This works well for installing the windows, but makes it difficult and expensive to replace them since these adjacent finishes must be removed.

Two alternate window details were developed to address the issue (see figure 5.13 and 5.14). In the first, the exterior finish returns as normal to provide the most water-tight seal, but the interior window is trimmed out with a wood jamb that can be easily removed, allowing the window to be removed from the inside. In this case a replaceable sheet metal weathering sill was installed that allows the base sill flashing to remain in place while the weathering sill is replaced. In the second detail, an unequal leg aluminum window is installed from the outside against flashing that is lapped under the exterior finish. This flashing ensures a water-tight connection between the window and cladding, but allows the window to be removed without touching the cladding.



REMOVABLE WINDOW : DETAIL A

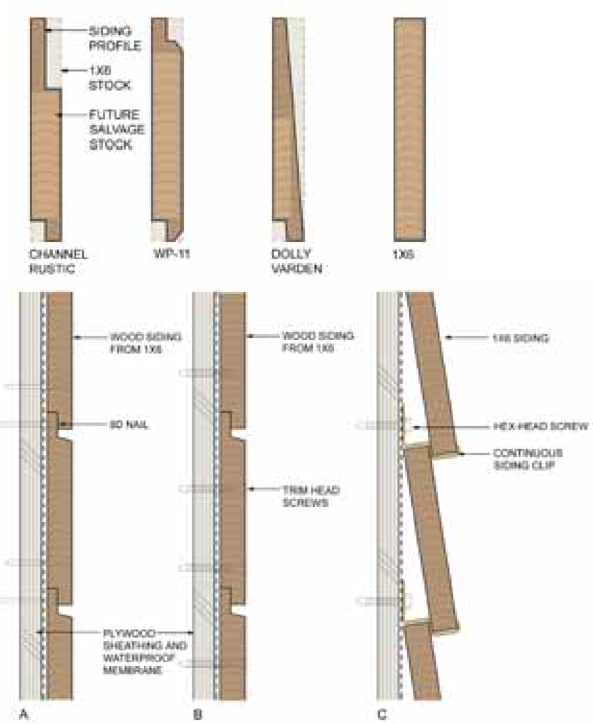


REMOVABLE WINDOW : DETAIL B

Some of the exterior finish at Chartwell School is old growth high grade redwood salvaged from large wine aging tanks (see figure 5.9) and supplied by Terra Mai. The wood is in remarkably good condition after years of use because it was held in place by metals bands that required virtually no fasteners and allowed it to be cleanly and easily recovered with very few defects. If the use of this material at Chartwell School could find a similarly non-invasive attachment method, perhaps now rare and valuable material can be salvaged again in the future. The first decision was what profile siding to use. The traditional siding pattern used at Fort Ord where Chartwell School is located is similar to WP-11 shown in figure 5.17. Quite a bit of material is lost as planer shavings in milling this profile. The intricacies of the profile such as tongues, grooves and chamfers are easily damaged during removal and are rarely feasible to remill. After looking at a series of siding profiles and the theoretical percentage of material that could be recovered after re-planing, a simple rectangular cross section was chosen as retaining the most value.

How to secure that profile is the next challenge. The first inclination is to replace nails with screws that can be removed. But screws are far from the ideal removable fasteners in construction. Even though the wood siding will not initially be painted at Chartwell, it is fairly likely that at some point in its life it will be painted over. This will conceal the screw locations and fill the head slots with paint making them very difficult to remove. While siding attached with nails can be readily pried off without knowing where the fasteners are located, even a single screw can be so strong that the wood fails before the screw yields when a board is pried off. And screws still leave a hole or defect in the wood after removal.

Figure 5.9



Exterior Siding Options

What is really needed is a something like the metal bands that held the salvaged wood together in the wine tanks—something non-invasive and easily removable. After quite a bit of experimentation, the clip shown in figure 5.10 was tested. It has a double bend, one bend to capture and hold the bottom of a siding board, and the second bend to secure the top edge. By using a hex head screw, removal at a future date is more reliable than a slotted head that could strip out. A mock-up demonstrated that the clip was surprisingly secure. If the small tab visible on the front of the siding was not desirable, it could seat into a small groove on the bottom of the siding.

The thickness of the clip provides a thin gap between the boards where they overlap, allowing ventilation and drying of the siding. This gap, however, also has a down side. In high fire risk zones, including the Chartwell School site, which is surround by undeveloped coastal oak forest, this gap reduces the fire resistance of the exterior wall. To minimize any added risk of fire, the detail was not used in the actual construction for the school. However, further development and use at a pilot project level appears warranted for this detail. The wood shown in this mock-up is recovered from a deconstructed bridge deck and supplied by Terra Mai.

A second exterior cladding attachment option is shown in figure 5.11. It conceptually uses a fastener system currently in use for decks, the Eb-Ty fastener. It is a football shaped polyethylene fastener that fits into slots in the edge of the board cut with a biscuit plate jointer. The boards are spaced approximately 1/8" apart with a trim head stainless steel screw installed through the clip to secure the boards. A similar clip could be engineered specifically for siding. The gap between the boards suggests a rain screen approach to this wall assembly. The disadvantage of this detail is that it requires cutting into the edge of the board, likely a continuous groove to reduce labor cost, and this reduces the recovery value of the boards to some extent.

Figure 5.10

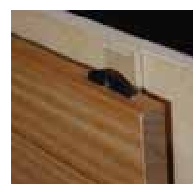
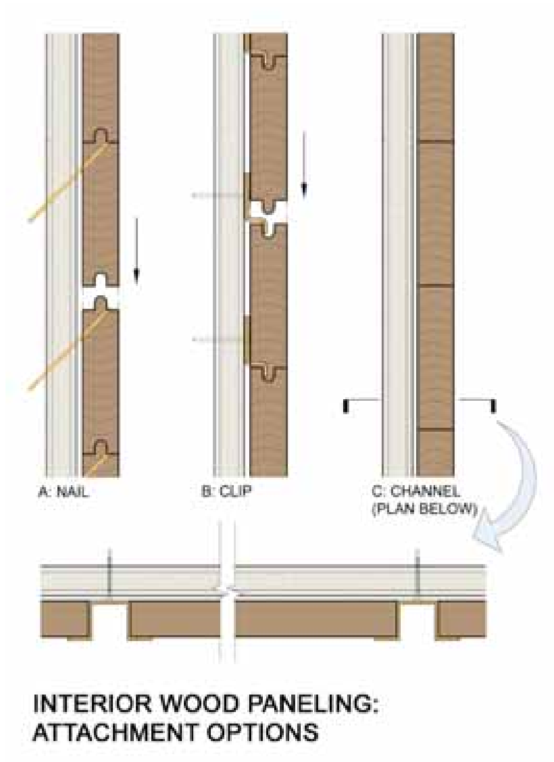


Figure 5.11



On the interior of the Multi-Use room at Chartwell School wood paneling is used as a wall finish to provide a durable and attractive surface. The wood is Douglas Fir recovered from the old barracks at Fort Ord shown being deconstructed in Chapter 2, and supplied by Pacific Heritage Wood Supply. Like the wood siding, this material maintains its value very well after recovery if it is reasonably free from defects. It is difficult to find new lumber asequal in quality and with the richness of color as the old growth vertical grain fir recovered from these buildings. Traditionally this material was installed as tongue and groove, being nailed at a 45 degree angle through the tongue to conceal the fastener. When removing this material, the thin tongue section inevitably breaks at the fastener, making it very difficult to salvage. A number of alternate attachment methods were examined for use at Chartwell School.

One option (see figure 5.12 and 5.12-B) is a thin metal clip that fits into the groove of a T&G profile. Clips often come with screws already engaged in the clip, so installation could be reasonably rapid. A mock-up demonstrated that this was quite a secure means of fastening, and could be readily removed by working in the opposite direction from installation. The downside of this technique is that, like the siding profiles discussed above, a fair amount of material is lost in planer shaving converting lumber to the T&G profile and the tongue and groove may not be desired for some unknown future reuse, leading to further loss of material. Also, when compared to the speed of a nail gun, the clips are fairly labor intensive increasing cost.


Figure 5.12-B


Figure 5.12

A second option (see figure 5.13 and 5.13-C) uses un-milled boards held in place by a hat-channel or similarly shaped reglet at the ends of the boards. The maximum practical length for boards held this way seems to be around 4'. The boards are full dimension with minimal loss of material from original milling, or from remilling for future reuse. The wood shown in this mock-up is resawn from 100 year old Douglas fir framing studs.

A third option for fastening interior paneling, and perhaps the most intriguing, is simply to use double stick tape (see figure 5.14). This is usually greeting with skepticism, and one of the lessons professional de-constructors repeat over and over is to avoid glues. Most important the tape must be engineered specifically for this function. It must be strong enough to hold the wood, but not so strong it cannot be removed. 3M makes a Very High Bond (VHB) tape rated at 200 pounds per square inch and used in a number of very demanding high load applications. That would clearly be overkill in this case, and not facilitate easy removal. However, if the foam the tape is made of was designed to yield at the correct force, a pry-bar could be easily inserted into the thin gap created by the thickness of the tape, and the board removed. The tape residue remaining on the board could be easily planed off, and there would be no defects or holes in the board. If it the paneling needed to be removed temporarily to access some utilities in the wall for example, it could then be simply reinstalled using new tape. This seems like a promising technology, though one that requires development and testing by a manufacturer.

Figure 5.13

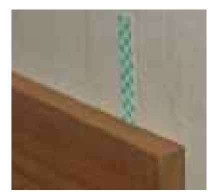


Figure 5.14

Facilitating Deconstruction through Information

One of the key challenges of DfD is not knowing what the future will bring, and future deconstructors not knowing how the building was designed to encourage disassembly. How do we convey this information in a way that will be accessible in 50 to 100 years? Most commonly an owner receives a couple of extra sets of drawings and specs at the end of a project, a conformed record set if they are lucky. For owners that are not used to managing buildings with a professional facilities staff, these documents are placed in a closet, and slowly disappear over the years as they are referenced by various trades for repair, architects or contactors for renovations or additions, or just get lost in the shuffle. Some building departments keep plans on file in an accessible manner, but the quality, consistency, and thoroughness of these records vary from place to place. Architects usually keep originals in their office or secure remote storage, but many offices do not last as long as their buildings, and future owners may not even know who the architect was. The problem is compounded with rapidly evolving software platforms that make it difficult to read digital documents that are even 10 years old. How can we retain all this information in a form that is accessible in 100 years?

What is needed is a “library” whose job is to store, maintain, and make accessible all this information. Ideally it would all be digital, kept up to date by the library, and made readily accessible in digital form to the owner and whoever they designate.

At Chartwell School several efforts have been made to make this information available in the future. As described above, many of the systems are exposed to view, including many of the utilities and the roof framing, so drawings are less critical in these cases. Final conformed record drawings will be bound with a sturdy cover to protect the paper, and will include instructions to get reproductions rather than removing drawings from the bound original. Some elements are directly labeled with critical information. For example, the roof trusses are labeled with their key structural properties, for use by structural engineers to determine if they are adequate for a future application. Finally, permanent signage will be installed in the school’s utility and maintenance rooms identifying the architects and engineering design team for future reference.

We hope and expect that in 50 to 100 years, deconstruction will no longer be the exception, but the rule. Deconstructing a building that had some forethought into that process will proceed faster, easier and at a lower cost than a conventional design. This can help shift our economy from a resource consumption based economy, towards a closed material cycle of use and reuse that minimizes environmental impacts while providing the resources needed to construct our built environment.

Additional Resources

Guy, Bradley and Scott Shell. Design for Deconstruction and Materials Reuse. Proceedings of the CIB Task Group 39 – Deconstruction Meeting edited by Abdol Chini and Frank Schultmann. CIB Publication 272, 2002.
http://www.cce.ufl.edu/Design for Deconstruction and Materials Reuse.pdf

Deconstruction – Building Disassembly and Material Salvage: The Riverdale Case Study. Prepared for the US Environmental Protection Agency, The Urban and Economic Development Division by NAHB Research Center. NAHB Research Center, 1997. http://www.epa.gov/epaoswer/non-hw/debris-new/pubs/river.pdf

Kernan, Paul. Old to New: Design Guide, Salvaged Building Materials in New Construction. Greater Vancouver Regional District (GVRD), 2002. http://www.gvrd.bc.ca/BUILDSMART/pdfs/OldtoNewDesignGuideFull.pdf

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Storey, John et al. The State of Deconstruction in New Zealand – Synopsis. Centre of Building Performance Research, 2003. http://www.zerowaste.co.nz/assets/Councilssolutions/TheStateofDeconstructioninNZSynopsis.pdf

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