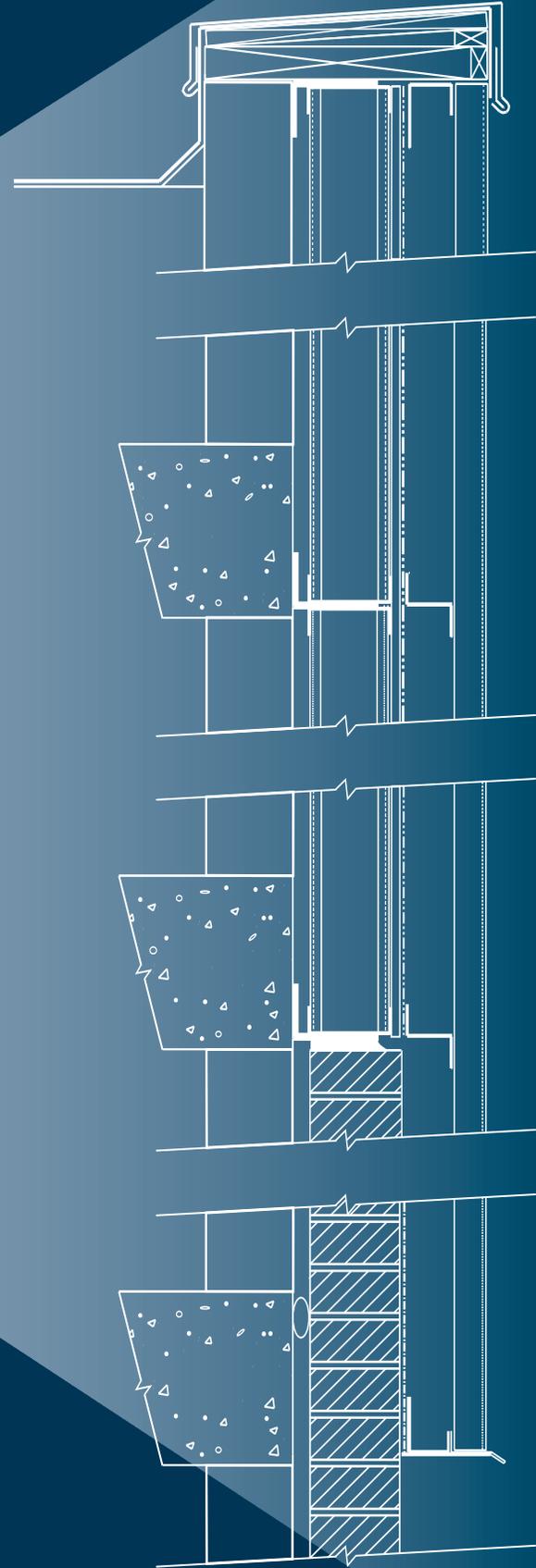


CSSBI

HOW TO SERIES...

Prefinished Sheet Steel for Retrofit Construction





CSSBI HOW TO SERIES

Preface

This How To Series publication is an educational tool intended to give guidance to anyone specifying sheet steel building products. This particular publication deals with the retrofit of the building envelope utilizing sheet steel. This is a generic guide giving the basic details and should only supplement the specific recommendations or design guidance published by the manufacturer appropriate to their own products.

The material presented in this publication has been prepared for the general information of the reader. While the material is believed to be technically correct and in accordance with recognized good practice at the time of publication, it should not be used without first securing competent advice with respect to its suitability for any specific application. Neither the Canadian Sheet Steel Building Institute nor its Members warrant or assume liability for the suitability of the material for any general or particular use.

Contents

	Page
Introduction	2
Why Retrofit for Building Repair?	2
Why Specify Prefinished Sheet Steel in Retrofit Construction?	3
Retrofit Checklist	6
Practical Guidelines for Retrofit with Prefinished Sheet Steel.	6
Retrofit Examples.	8
Conclusions.	16
Additional Prefinished Sheet Steel Information	16



Copyright © July 2004
All rights reserved. This publication, nor any part thereof, may not be reproduced in any form without the written permission of the publisher.

CSSBI S16-2004
ISBN 1-895535-43-3



Introduction

Prefinished sheet steel is one of the most economical, versatile, attractive, durable, environmentally responsible and easy to use construction products in the country today. Not only is it widely used in new building construction; prefinished sheet steel is a popular choice for retrofit construction. The product combines attractiveness, economy, ease and speed of construction and excellent performance for a wide range of applications in most geographic areas and environments.

Prefinished sheet steel has been used on Canadian buildings since the mid 1960's. Prefinishing encompasses a system of factory-applied paint over a metallic coated, lightweight sheet steel product. The principal application for prefinished sheet steel is roll formed panels or cladding. The cladding can be used on residential, institutional, commercial and industrial buildings. CSSBI member fabricators offer a wide variety of prefinished sheet steel systems for these applications.

This publication is intended to be a resource for building owners, architects and engineers who may be considering repair of an existing building through the technique of retrofit using prefinished sheet steel. It shows how retrofit with prefinished sheet steel offers an effective and economic solution and provides information, guidelines and examples.

Why Retrofit for Building Repair?

There are various reasons for the repair and rehabilitation of a building. There is often the need to improve moisture control and thermal performance due to deterioration, out-of-date construction technology or poor assembly practices. The building may be losing tenant appeal due to ongoing deterioration or the owner may wish to improve aesthetics to enhance the attraction of the building to new clients. In extreme cases, it may be necessary to restore the structural integrity of the building or enhance safety for its occupants and passers-by. Retrofits are often undertaken to satisfy any one of these needs.



When contemplating a building retrofit project, a cost that permits an attractive return on investment will be foremost in the mind of the building owner. Anticipated capital cost of the retrofit can be a major factor in the decision to rehabilitate or replace the building. By retrofitting with sheet steel products, the owner can also expect reduced operational costs through enhanced thermal performance, better moisture control for fewer interior repairs (and happier tenants) and equal or better exterior durability. In many cases retrofit construction does not need to interfere with the day-to-day activity in and around the building, or force the temporary relocation of tenants. A better-looking building after the retrofit may also attract higher rental income. Ideally, a retrofit should combine the attributes of minimum construction cost, reduced



operating costs and enhanced building marketability during and after the project.

Retrofit is a reparation technique through the application of a new material over part or all of the building to return it to a useful and desirable state. Retrofit using steel is often the least expensive remedial method. Most retrofits involve the building façade, and repair of the facade with prefinished sheet steel is an ideal and obvious material choice achieving the maximum cost benefit for the project. The following will expand on this theme and guide the user in the use of prefinished sheet steel for retrofit.

Why Specify Prefinished Sheet Steel in Retrofit Construction?

Retrofit using prefinished sheet steel provides a highly cost effective solution for the existing building envelope. Here's how:

Cost

In new construction, prefinished sheet steel is often the least expensive cladding material choice in comparison





Table 1: Indexed Cost of Wall Systems^{1,2} New Construction Only

System Description	Indexed Cost
12 inch, architectural, split face masonry	1.8
6 inch masonry backup, 2 inch rigid insulation, air barrier, masonry veneer	3.5
Commercial precast, core insulation, cement finish	3.0
Architectural precast, core insulation	4.5
Exterior insulating finish system	3.0
Prefinished sheet steel wall system: sheet steel cladding and flashings, insulation, interior liner sheet (metallic coated) with subgirt	1.0

¹ Building envelope only. Structural support for wall and building not included.

² Source: Means Cost Data – 2001

to masonry, pre-cast concrete and stucco-finish systems, as shown in Table 1. Although this data reflects new construction and should not be interpreted as a strict guide for repair construction, the cost-effective trend is evident. The versatility and range of quality prefinished sheet steel profiles provides attractive panel systems that will accommodate almost any budget.

Product Versatility

From a design viewpoint, prefinished sheet steels are produced in high strengths and a wide range of thicknesses. The formability of sheet steel allows it to be manufactured in many profiles and shapes. These attributes permit the engineering of building panels to meet demanding loading requirements (high loads and long spans between supports) of most buildings.

Prefinished sheet steel panels allow easy integration with other building materials such as liner sheets and insulation to further extend into a building envelope system with increased application possibilities. The addition of insulation along with an effective rain screen design will provide both greater thermal properties and better moisture protection.

Prefinished Systems

Prefinished sheet steel is attractive. A rainbow of colours allows vast creative opportunities for design projects. The wide choice provides the ability to design colour into a building so that it closely matches or compliments the finish on the current structure. If desired, the entire building can be clad with a colour

selection that will let it stand out on the horizon or blend into the neighbourhood.

Prefinished sheet steel is durable. Coating systems have been developed and proven in a diverse range of environmental conditions since the 1960's. Prefinished product has been successfully incorporated into numerous types of structures across North America, from extreme climatic fluctuations of the prairies, to corrosive industrial environments and to severe





conditions in coastal maritime (marine) locations. Minimum maintenance will keep the cladding fresh and attractive for many years to come. Other systems of exterior wall finishes have not had the same length in service as prefinished sheet steel.

Prefinished sheet steel is lightweight allowing easy handling, speedy erection and all-season installation. In most cases, erection will not need expensive and disruptive scaffolding. Panels arriving on site and after unloading can be erected immediately with relatively light field equipment and ordinary tools. There is no wait time for drying or curing. Panel systems that incorporate insulation reduce or eliminate the need for that trade. Other trades can work alongside or quickly follow installation of the panels.

Environmental Benefits

Prefinished sheet steel is environmentally responsible. Steel is the most recycled manufactured material on earth. In North America alone over 70 million tons of steel are recycled annually. This is done for economic as well as environmental reasons. It is always cheaper to recycle steel than to mine virgin ore and move it through the process of making new steel. However, it should also be clearly understood that many steel applications are durables, and even though two out of every three pounds of new steel are produced from old steel, the fact that cars, appliances, and bridges last a long time makes it necessary to continue to mine virgin ore to supplement the production of new steel.

Economic expansion, domestically and internationally, creates additional demand that cannot be fully met by available scrap supplies.

Unlike other construction market building products, recycled content in the steel industry is second nature. The North American steel industry has been recycling steel scrap for over 150 years through the 1,800 scrap processors and some 8,000 auto dismantlers. Many of them have been in the business since the turn of this last century.

For more information on recycling steel visit the web site of the Steel Recycling Institute at www.recycle-steel.org

LEED™ Documentation for Steel Building Products

LEED (Leadership in Energy and Environmental Design) is a rating system developed by the U.S. Green Building Council to assess the environmental sustainability of building designs. LEED is a point-based rating system; points are earned for building attributes considered environmentally beneficial. LEED differs from other rating systems in that it has quantified most of the "green credits". LEED is currently the most recognized green building rating system in North America.

LEED measures and ranks a building's environmental performance in terms of six general categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor



Prefinished Sheet Steel for Retrofit Construction

Environmental Quality, and Innovation & Design. Points are awarded for achieving specific goals clearly outlined in each category. Sheet steel building products can be credited with the maximum number of points for the Material Credit aspect of the rating system.

The LEED program is voluntary, however, some U.S. municipalities have adopted a minimum LEED standard for all new public buildings as a matter of policy. A Canadian version of LEED is under development. It is similar to the US version with the exception that energy efficiency is relative to the Canadian Model Energy Code for Buildings and the associated program materials requirements reference Canadian building standards.

Retrofit Checklist

When considering retrofit repair for a building, there are several items the building owner, architect and engineer need to consider regardless of the approach and construction material type. A checklist is presented in Table 2 to assist in the preparation of a



thorough job specification so that competing quotes are directly comparable. By recognizing the entire scope of work at the outset, a retrofit project will proceed smoothly and the invested dollars will have a higher future payback.

Practical Guidelines for Retrofit with Prefinished Sheet Steel

When the building owner decides it is necessary to affect repairs, an experienced architect or contractor are the best sources for advice on developing a retrofit specification. Contractors often work in concert with an architect, and a structural engineer may also be retained to assess the required upgrades. When retrofit with prefinished sheet is a considered retrofit scenario, the manufacturer of the prefinished sheet steel system may also be involved as a further source of advice.

There is no a generic specification for retrofit procedures. However, architects, engineers and

Table 2: Retrofit Checklist

Item	Comment
Structural adequacy of the current building	Assess the current structure with respect to its structural capabilities. Determine the extent deterioration has rendered the building structurally unsound or a danger to its occupants.
Structural support for the proposed retrofit	Engineer the retrofit for: <ol style="list-style-type: none"> a. Support of required design loads b. Spacing and span conditions c. Building code requirements
Thermal properties	Evaluate thermal properties of the current building. Determine whether the proposed solution with thermal upgrade provides adequate payback or meets target.
Thermal expansion	Determine that the retrofit thermal expansion is adequate for itself and other elements in the building.
Moisture infiltration	Ensure proper drainage. Protect against water infiltration.
Air & vapour barriers	Incorporate continuous air and vapour barriers into the retrofit.
Long-term performance	What is expected for long-term endurance? What is the desired performance with respect to durability (colour retention, resistance to cracking, etc.) in consideration of climatic exposure.
Aesthetic objectives	Determine the solution that achieves desired aesthetics with respect to colour, profile, texture, trim, etc.
Reliability of source	Deal with an experienced and reliable designer, manufacturer and installer of the retrofit system.
Liability protection	Design drawings should have a Professional Engineer's stamp



contractors can consult with the Retrofit Checklist above and review the following guidelines:

- Any retrofit may be viewed as a change by the local building authority and the retrofit must adhere to requirements of the applicable provincial and local building codes.
- Pay particular attention to tall, masonry clad structures where the corners, protrudences, upper storeys and north walls of an ageing structure often suffer the most deterioration.
- Attach the prefinished sheet steel system to an adequate structural supporting system such as a structural steel frame or concrete floor slab.
- When the retrofit must involve attachment of the sheet steel system to masonry, field test the anchors to determine capability (pull out capacity).
- When attaching the steel panels to masonry, there will be a maximum span limit between the fastener supports. Consult the panel supplier for further guidance.
- Prefinished sheet steel panels offer an opportunity to include insulating material to enhance the thermal performance of the building. Ensure a continuous vapour barrier to maintain the effective performance of the insulation. Provide details to ensure adequate water drainage if the panels serve as a rain screen.
- In retrofit, steel is usually a different material than that to which it is attached and thus has different thermal expansion properties. Differences in thermal expansion between the materials can cause unacceptable loading and deflection leading to damage to the steel, the substrate or both. Simple expansion details will minimize or avoid problems. Consult the supplier for further guidance.
- Accessories such as adjustable angles can be used to accommodate minor out-of-alignment in the wall of an existing structure.





Retrofit Examples

APARTMENT BUILDING IN KITCHENER, ONTARIO

This is a 6-storey residential structure of reinforced concrete and masonry. The building exterior comprised alternating vertical ribbons of uninterrupted exterior clay brick with 13 in. wide brick pilasters at each side and infill with stucco-faced concrete block and aluminum windows. The building was experiencing exterior masonry deterioration that was extreme and extensive in nature. A large percentage of the clay brick at the upper floors had spalled to a point of concern over the safety of the structure and building occupants.

The exterior walls were double wythe comprising a 4 in. concrete block backup, 1 in. air space and 4 in. exterior clay brick. The vertical runs of stucco wall were applied over a 4 in. concrete block infill between non-thermally broken, single glazed aluminum windows.

Canadian Construction Controls Limited of Breslau, Ontario (CCCL) performed a condition assessment of the building envelope components and determined



Extensive spalling of the masonry veneer before retrofit

that up to 40% of the brick masonry was affected, particularly at the upper storeys, and at all balcony privacy walls. Causes of the brick spalling were determined to be:

- poor brick quality (relative to freeze-thaw cycling);
- poor installation of the backup concrete block wall where it was suspected that interior air leakage at the upper floors played a significant



Table 3: Merits and concerns for prefinished sheet steel retrofit and other repair options

	Repair Option: Masonry restoration	Repair Option: Exterior insulation finish system (EIFS)	Repair Option: Insulated prefinished sheet steel cladding
Merits	<ul style="list-style-type: none"> • Maintain original appearance • Durable material 	<ul style="list-style-type: none"> • Improved thermal efficiency • Improved air barrier 	<ul style="list-style-type: none"> • Improved thermal efficiency • Improved air barrier • Minimal structural substrate repair • Potential aesthetic enhancement • Ease of un-interruptive repair (swing stage access) • Low maintenance • Low capital cost
Concerns	<ul style="list-style-type: none"> • Availability of matching brick • Costly detailing improvement for structural and thermal expansion • Minimal thermal efficiency improvement • Potential future brick deterioration • Repair intricacy (access by scaffolding) • High capital cost 	<ul style="list-style-type: none"> • Requires full masonry restoration and upgrade for suitable structural substrate • Uncertain future required maintenance to address coating and sealant deterioration • Expensive and interruptive repair scheme (access by scaffolding) • High capital cost 	

role in the moisture saturation of the brick during the winter months; and,

- design and detailing deficiencies that lead to significant brick and mortar joint cracking at upper floors due to the lack of vertical control joints and horizontal relief in the form of shelf angles.

The many concerns needing attention relative to the appropriate retrofit scheme included structural, aesthetic, serviceability, durability and energy performances. The retrofit options had to consider improved air tightness at the upper storeys, wall restoration to meet the intent of building construction standards, accommodation of thermal differential movement, improved water shedding and improved protection of the left-in-place brick. In addition, the retrofit strategy also needed to maintain or enhance the aesthetic characteristics to ensure current and



Retrofit in process

Prefinished Sheet Steel for Retrofit Construction

future building marketability. Finally, code requirements pointed to the size inadequacy of the 4 in. concrete block backup.

Based on preliminary costing, three retrofit options were evaluated as summarized in Table 3. Based on this assessment, the client chose the insulated prefinished sheet steel cladding system installed over the critical upper stories combined with masonry brick repair for the lower floor areas. A preliminary budget estimate with this option pointed to a cost savings of between \$150,000 and \$200,000. The savings are attributed to the significant cost for the other two options of providing a structurally sound substrate.

The prefinished sheet steel system incorporated the steel cladding, a polyolefin air barrier membrane, galvanized metal girts to secure the steel panels and semi-rigid mineral wool insulation in the girt spaces. The profile of the 1.5 in. deep steel panel was selected because of its high strength-to-weight ratio and its strong profile. Where the masonry substrate was completely removed, insulated steel stud (with track) wall panels¹ were installed and clad with exterior grade



gypsum board sheathing. The stud wall tracks were indirectly secured to the existing floor and roof slab edges and the galvanized girts were indirectly supported by the stud wall track. A number of the details are illustrated in the accompanying drawings.

Where the masonry was not completely removed, repairs included brick replacement, application on the spalled brick of polymer-modified mortar patching and installation of stainless steel ties for left-in-place brick between it and the concrete block. Further remedies included patching the voids around windows and elsewhere, application of a self-adhering air barrier extending from window frame to the barrier in the steel cladding system and parge repairing by an elastomeric coating at existing stucco finished infill panels between windows.

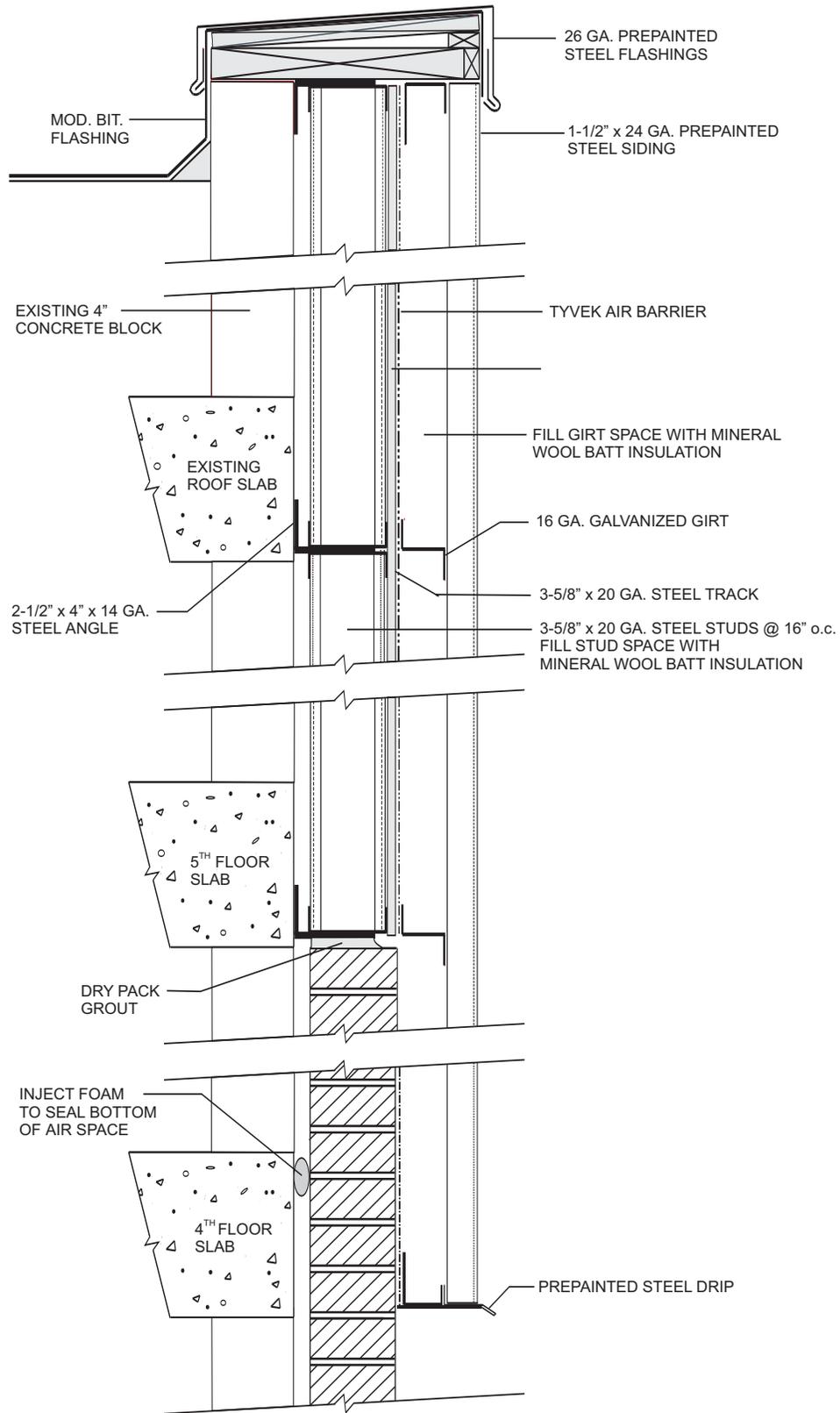
Construction work was completed over a period of 20 weeks. It was found during the removal operation there were more areas of the brick masonry and block wythe backup deterioration than anticipated by the condition assessment. The work was carried out from swing stages throughout all elevations.



Finished building



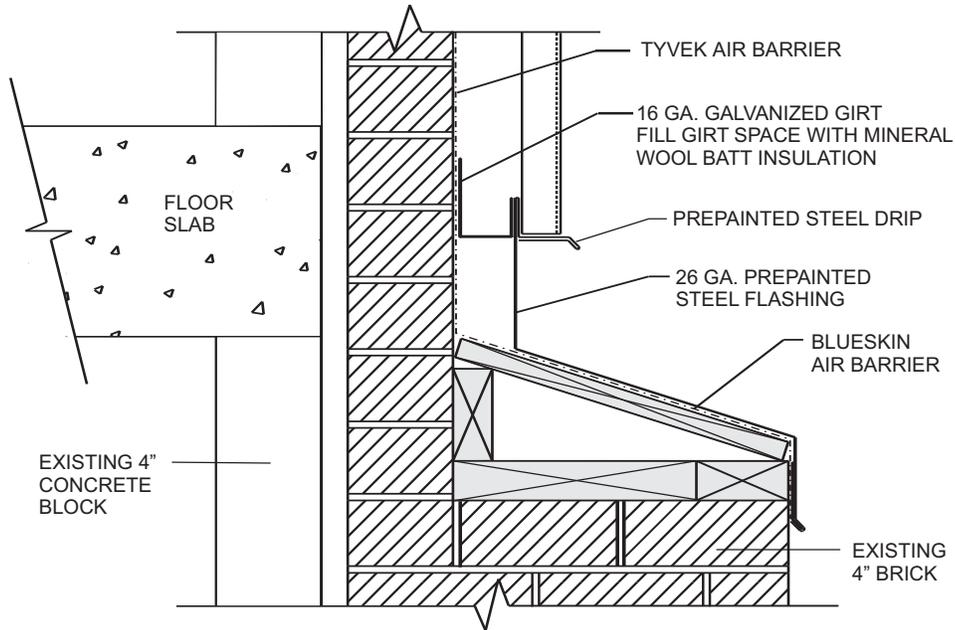
Details



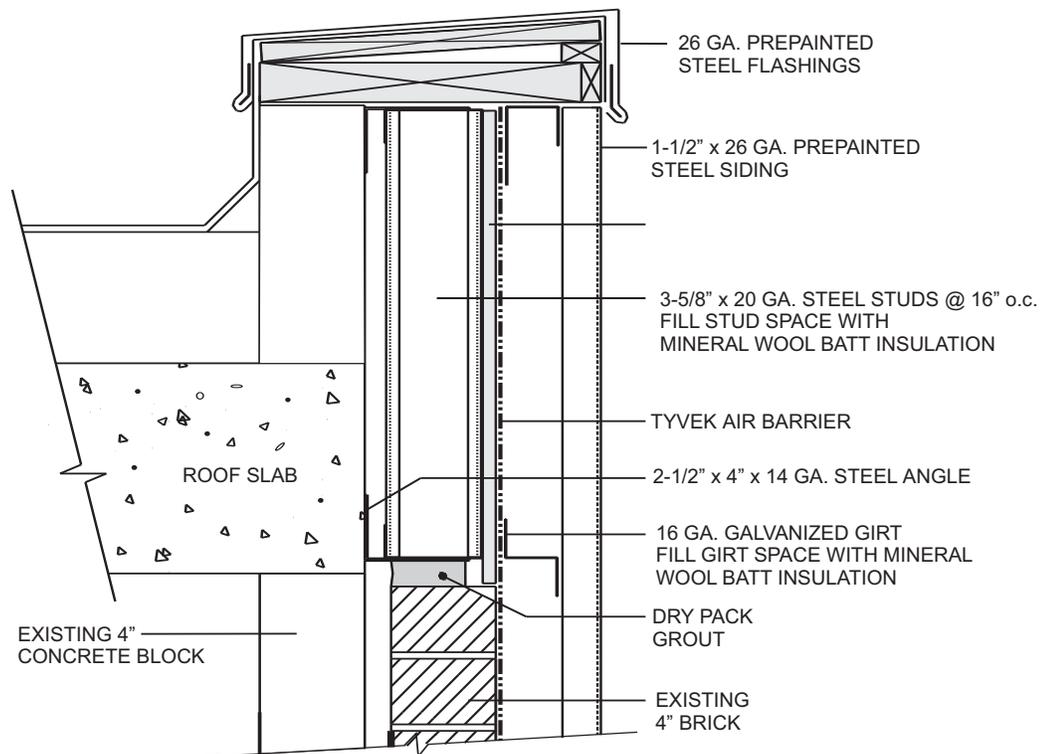
Cross Section of Typical Wall Reconstruction



Prefinished Sheet Steel for Retrofit Construction



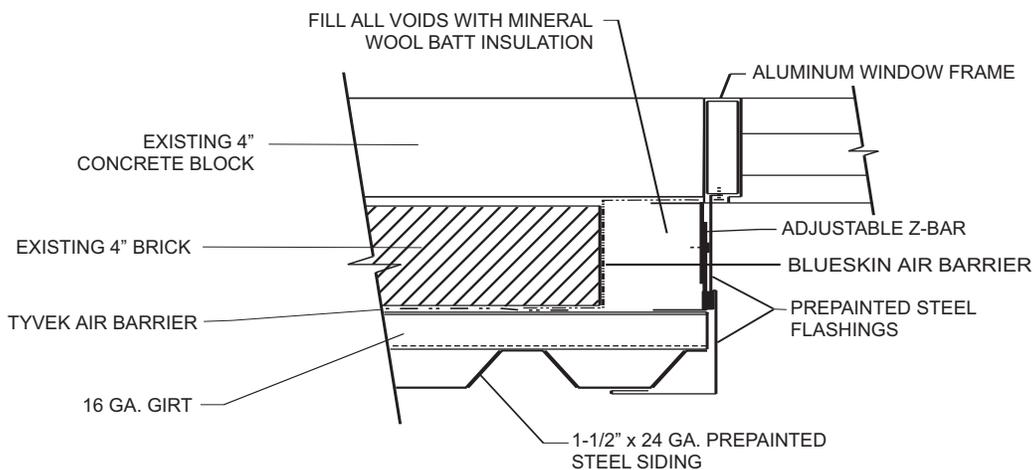
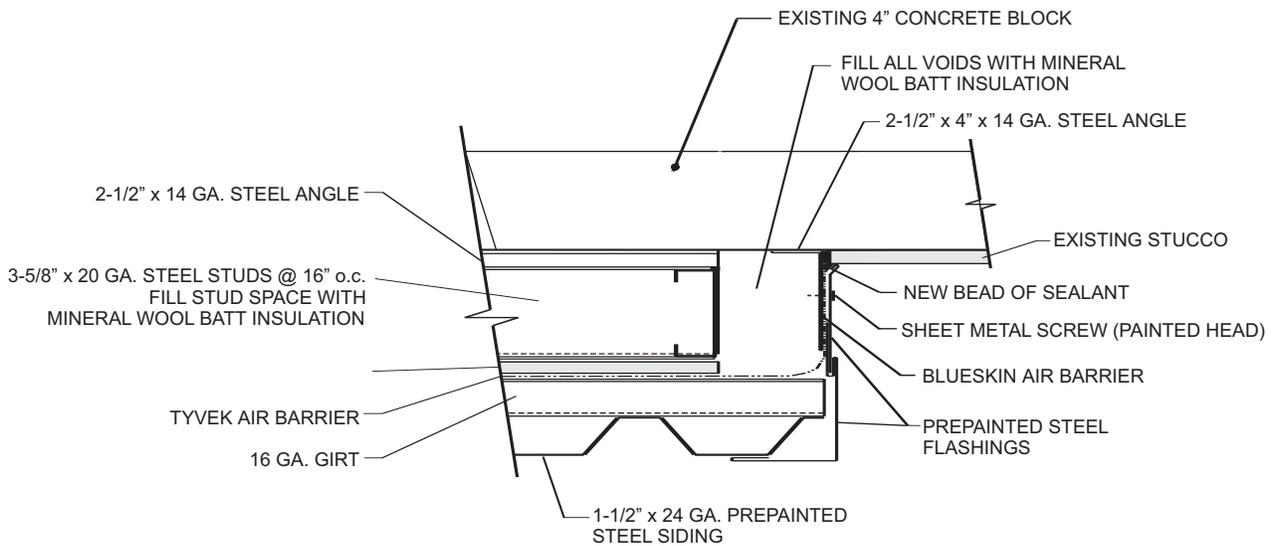
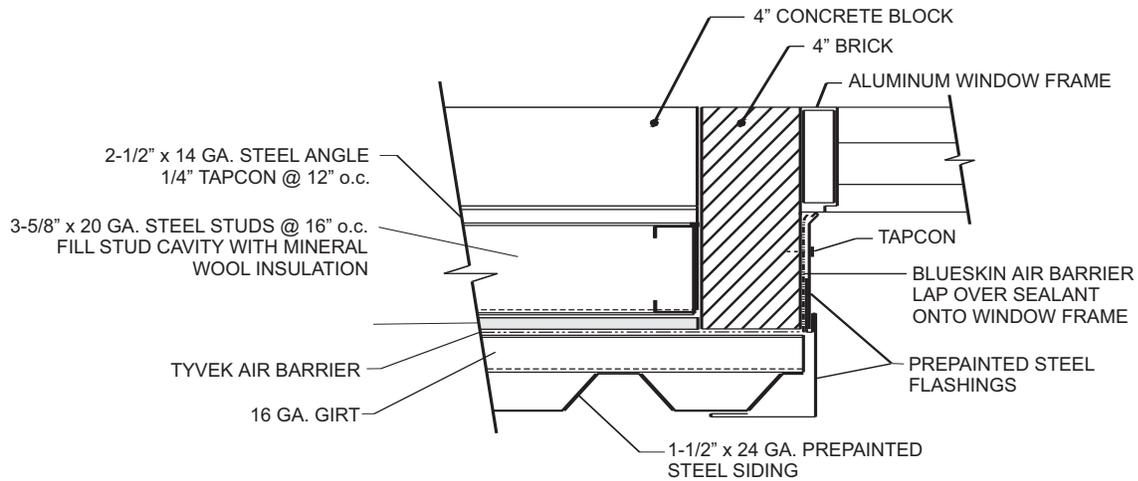
Retrofit of Pier Caps



Parapet Reconstruction



Prefinished Sheet Steel for Retrofit Construction



Flashing at Window Openings



Prefinished Sheet Steel for Retrofit Construction



APARTMENT BUILDING IN ST. CATHARINES, ONTARIO

The masonry veneer experienced extensive deterioration over much of the top four floors of this large, 2000 unit, ten-storey apartment building. Repairs to, or removal and replacement of, the veneer down to the top of the sixth floor were carried out. Repairs continued on with installation of self-adhering insulation on the masonry, followed by the application of prefinished sheet steel cladding. The cladding was fastened to purlins anchored to the floor slabs and midway between the floors. (Reference – The RESTORERS Group Inc.)



Masonry veneer repair phase underway



Sub-girt installation and partial retrofit with sheet steel cladding



Successful retrofit with prefinished sheet steel

CHURCH IN ST-LAZARE, PQ

The roof of a church in St-Lazare, Quebec was in need of repair. The decision was made to go with a sheet steel roof over the existing asphalt shingles. The roof cladding was a hidden fastener profile with a 10 000 Series paint system. The colour was chosen to match the copper clad steeple.



St-Lazare church during roof retrofit application



Prefinished Sheet Steel for Retrofit Construction



St-Lazare church completed job

APARTMENT BUILDING IN SAINT JOHN, NB

Built in 1968, this building was experiencing leakage into the interior apartments, as well as exterior deterioration of the original brick veneer/wall assembly and balconies. The problem was corrected by replacing the original brick/veneer/insulated wall with a new wall assembly meeting current design standards, including air barriers, upgraded insulation, new windows and a 'rainscreen' type wall assembly." As a result, it was necessary to remove both the original masonry and the



Prepainted sheet steel cladding used to reface the exterior of the structure

balconies. The renovation was done with minimum tenant disruption.

The curtain wall solution used was a profiled sheet steel panel prefinished with a 10 000 Series paint system coloured Arctic White and Twilight Blue. Galvanized steel hat sections, channels and angles were used to attach the prepainted steel panels to the building structure.



Original masonry was removed to rectify building problems and replaced with a new wall assembly to current design standards



Panels being fastened to typical hat section used around window openings

Prefinished Sheet Steel for Retrofit Construction

APARTMENT BUILDING IN RICHMOND HILL, ON

A low-rise apartment complex in Richmond Hill was renovated with the addition of a new pitched roof to cover the old flat roof. The roof slope was created with cold formed steel roof framing, and prepainted sheet steel tile roofing installed over top.



Roof framing complete



Steel roofing being installed



Completed job



Conclusions

Retrofitting with prefinished sheet steel is an effective means of improving the aesthetics, thermal and moisture performance of a building. Retrofit with steel can often be accomplished without major interruption to building function and at most times of the year. Prefinished sheet steel is one of the most cost effective building materials available today and this economy extends into retrofit projects. The previous examples show the versatility of prefinished sheet steel in these applications. Anyone considering a building retrofit is encouraged to consider the advantages of prefinished sheet steel.

Additional Information on Sheet Steel Building Products

The following publications related to prefinished sheet steel building products are available from CSSBI:

- Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications, CSSBI 20M-99
- Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products, CSSBI S8-2001
- How to Series Insulated Sheet Steel Wall Assemblies, CSSBI S10-99
- How to Series ... Insulated Sheet Steel Roof Assemblies, CSSBI S11-2000
- How to Series ... Lightgauge Steel Roofing and Siding, CSSBI S14-2000

For a complete list of CSSBI publications, visit our website at www.cssbi.ca or contact our office at the following:

652 Bishop St. N., Unit 2A
Cambridge, ON
N3H 4V6
Tel.: 519-650-1285
Fax: 519-650-8081
Email: info@cssbi.ca

CANADIANSHEET STEEL BUILDING INSTITUTE

The CANADIAN SHEET STEEL BUILDING INSTITUTE, the national association of the structural sheet steel industry, promotes the use of sheet steel in building construction through engineered design and standards of quality and performance. Activities focus on sheet steel building products, lightweight steel framing and steel building systems for commercial, industrial and institutional applications and similar products and systems for farm applications.

The Institute provides information regarding the standards of design, fabrication and erection, and offers technical assistance in the use of cold formed and engineered sheet steel products. The CSSBI also represents its members in technical matters connected with government, and provides liaison with other industry organizations and standards writing bodies.

CSSBI Member Companies are voluntarily committed to maintaining high industry standards in the design, manufacture and installation of cold formed steel building products and systems. Specifying requirements to CSSBI Standards and dealing with CSSBI Member Companies, can provide added assurance of quality construction. Only CSSBI Member Companies are authorized to display the CSSBI logo on drawings, stationary, company literature and advertising.

652 Bishop St. N., Unit 2A
Cambridge, ON
N3H 4V6
Tel 519-650-1285
Fax 519-650-8081
www.cssbi.ca



CSSBI S16-2004
ISBN 1-895535-43-3

