Nudura

INSTALLATION GUIDE

Insulated Concrete Forms by Nudura

TREMCO
Construction Products Group

Empowering People to Build More Efficiently

Nudura solid insulated wall technology provides design professionals, architects, homeowners and contractors the freedom and versatility to design and build structure the way it was envisioned.

Nudura Installation Manual

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Disclaimer Notice

The information contained in this Installation Guide is presented as a "Guide Only" to the installer for the purpose of assisting them in more easily adopting the use of the Nudura Insulated Concrete Wall Forming System ("Nudura") in lieu of more traditional wall construction methods. Where aspects of any building design stray outside of or beyond the scope of prescriptive design as established by this manual AND adopted Building Codes for your region, this Manual SHALL NOT be used as a substitute for professional engineering consultation.

This manual mainly focuses on residential building techniques; while the methods used in commercial construction are similar, commercial buildings may have special requirements not detailed in this manual. Be sure to consult relevant building codes and specifications before proceeding with any project to ensure all applicable regulations are observed. To avoid injury, comply with local safety regulations, and follow ALL tool and material MANUFACTURERS' INSTRUCTIONS and SAFETY GUIDELINES.

Detailing formats, material composition, and references contained herein have been formulated to reflect general infield residential installation practices. The manual features selected details that reflect foundation, floor and roof details commonly found in Europe.

As well. The reinforcing formats shown in detailing are suggested formats for general installation reference only, and are subject to amendment or modification by any Design or structural Engineer of Record. Final reinforcing steel bar diameter, placement and spacing remain the sole responsibility of the Engineer of Record for the project in question. It is the Engineer's and Contractor's sole responsibility to assure that details and reinforcing have been designed and installed in full compliance with the provisions of all local and applicable governing codes and standards.

Nudura makes no general warranties to the specific applicability of any of the contained details to any or all situations for which the designer may elect their specific use. Final amendment or modification to suit the exact circumstance of employment of such details is the responsibility of the project designer or the structural engineer.

Nudura will not be responsible for the installation or workmanship used in the assembly or the installation of Nudura. Therefore, Nudura shall not be liable for any general, special, direct, indirect or consequential damages, including, but not limited to, bodily harm that may be suffered by any person including, without limitation, the installer, contractor, architect, engineer, homeowner or customer due to the use, assembly or installation of Nudura.

Who Can I Contact?

Sales & Technical Support

Technical Support is available through your local distributor. The distributor is your first line of contact for assistance as they can best identify with your local applicable codes and conditions common to your region.
To locate your local distributor please contact the Tremco CPG head-office in your country/region.

What Does the System Include?

Nudura is a building product system that combines a comprehensive array of building products that are dedicated to enabling designers and builders alike to create one of the most flexible and energy efficient building envelope systems available on the market today. As outlined in the Nudura Product Catalogue, the system includes:

- The Nudura Wall Form System (including all of its related accessory products)
- Nudura Floor Technology
- Nudura Ceiling Technology

These products when used together in any building structure, enable the designer and builder to create building envelopes that when combined with a properly designed mechanical system, are statistically known to provide end users with living environments that can deliver substantial savings on annual energy costs over conventionally constructed buildings.

Where Do I Get More Info?

Nudura Website

The Nudura website is a valuable tool for designers, engineers, and contractors. There you will find the most recent updates on our manuals, public access testing reports, evaluation reports, technical bulletins and current news. The construction professional section of the website is a great source of information for all of your construction questions. Should additional information be required, please contact your local distributor.

www.nudura-europe.com

Scan me
with your smartphone

1.0 Introduction

If you are a designer or builder who has never worked with Insulated Concrete Form Technology before, this manual (in combination with the Nudura Installation media), will prove to be an invaluable guide in designing and working with Nudura Forms. If you have never worked with Insulated Concrete Forms before, you will find many advantages over conventional building material design and construction.

1.1 THE FORM

Nudura Insulated Concrete Forms consist of two lightweight expanded polystyrene (EPS) foam plastic panels manufactured to a nominal EPS foam density of 21.6 kg/m^3. The EPS panels are connected together with either integrally molded foldable high-density polypropylene hinged web/fastening strips or injection molded high-density polystyrene fastening strips interlinked with high-density polypropylene insert webs. Additional features include full height fastening strips every (203 mm).

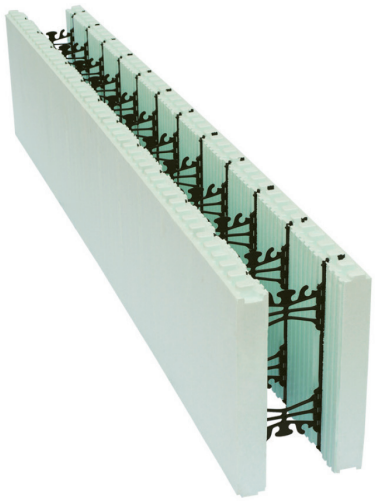


Figure 1.01

The Nudura wall system completes 6 building steps with one product providing:

1. The concrete form system
2. Wall structure (structural reinforced monolithic concrete)
3. Insulation
4. Air barrier
5. Vapour barrier
6. Interior and exterior fixing points

Having six wall elements in one product eliminates costly building steps, and allows the building project to be constructed faster and more efficiently.

For those of you that are perhaps familiar with insulated concrete form systems trying Nudura for the first time, you will find several features that set Nudura clearly apart from other insulated concrete form systems.

DURAMAX TECHNOLOGY®

Nudura forms are double the length of most other insulated form systems. While most systems feature forms at 1.2 m in length, Nudura Forms are a full 2.44 m. In addition, the form height is set at 457 mm. This means that every time an installer is placing a form, they are placing a full 1.115 m^2 of formwork in one motion.

Figure 1.02

4-WAY REVERSIBLE SYSTEM

All of the Nudura Form line-up feature top and bottom edges and are molded with a robust, continuous, fully reversible interlock. This means superb flexibility infield, automatically doubling form usage whenever a half height form may be required, enormously less waste when constructing gable end walls, since both halves of the cut form can be used and the best part – no left and right corners to have to worry about having on hand during construction.

DURALOK TECHNOLOGY®

Besides the reversible interlock of the EPS panel edges, the embedded web/fastening strips run the full 457 mm height of each and every form, end cap and height adjuster accessory. Each fastening strip is embedded in the EPS at consistent 203 mm intervals and are 38 mm wide an recessed 16 mm from the surface. Each fastening strip is also fitted at the top and bottom edges with a patented reversible triple tooth interlock.

Figure 1.03

Combined together, these features enable every form to solidly lock together in field, preventing form separation during concrete pour and enabling easy stacking and interlocking of the form system. No longer are forms dependent on simply EPS to EPS foam contact for assembly. This minimizes separation of the EPS forms along the horizontal joints, and eliminates form compression during concrete placement, resulting in rapid, solid construction, less form support having to be installed, and in the end, straight and plumb walls. Further, no longer does form settlement have to be planned for at openings in the construction of the wall system.

The webs connecting to the fastening strips across the concrete core also have openings to permit concrete to pass through, and feature a variety of seat options for support and locking of horizontal steel reinforcing bars.

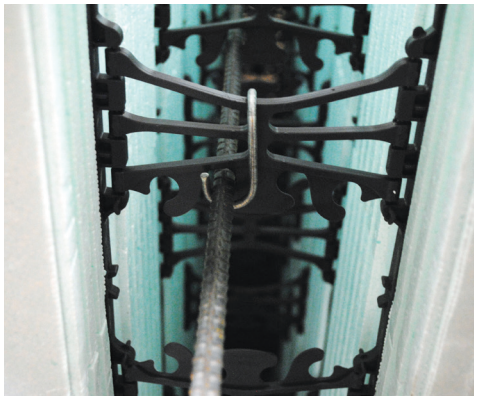


Figure 1.04

DURAFOLD TECHNOLOGY®

One of the best features of all is Nudura's patented hinge folding mechanism. This allows for efficient shipping, convenient packaging, and the forms arrive at the site flat for efficient on site storage. With a simple opening technique, they can be hinged open instantly for use. 4 steel hinge pins on each web are the secret, and these serve to solidly hold the form at its required shape once opened. The flat ship format enables the forms to be shrink wrapped and bundled with 3 forms to a package with a finished bundled weight of approximately 21 kg.

The same insert web technology provides even more flexibility to the Nudura System as the system can be purchased as either fully assembled forms or as a knock-down system of panels and insert webs. BOTH technologies can be married to each other in-field to suit almost any building application (or in-field build problem) imaginable.

Figure 1.05

OTHER FEATURES AND BENEFITS

Nudura walls provide a fire resistance rating of up to 4 hours, a Sound Attenuation of min. SRI 51 152 mm core and above), as well as an insulation value of U 0,24 Rsi 4.14. The EPS foam combined with the concrete mass, results in a potential for the wall assembly to perform equivalently to a low mass wall assembly insulated to a level of U 0,11 (Rsi 8,8) depending upon geographic location.

COMPREHENSIVE FORM AND ACCESSORY SYSTEM

The Nudura form system is among the most comprehensive form systems
available on the market today enabling the construction of the following
core cavity thicknesses of walls,

- 102 mm (4")
- 152 mm (6")
- 203 mm (8")
- 254 mm (10")
- 305 mm (12")

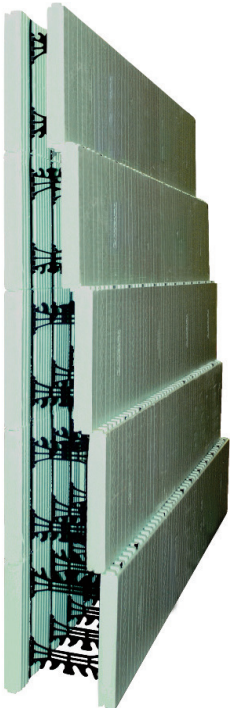


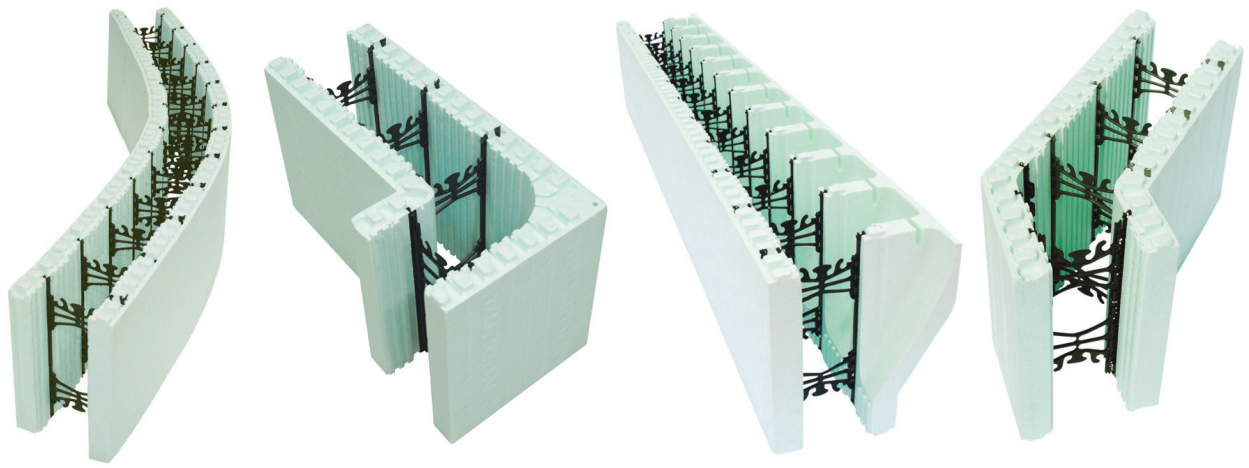
Figure 1.06

1.1 NUDURA SERIES

In ANY core thickness, the following form profiles are available for the construction of walls in any desired configuration:

- Standard (straight run wall) Form Units
- 90 degree Corner Form Units
- 45 degree Corner Form Units
- Taper Top Form Units (enabling concrete to approach the exterior or interior (or both) edges of the form at its top edge)
- Brick Corbel Form Units (for creating support of brick or stone masonry veneers)
- Brick Corbel Extension Forms (enabling creation of brick corbels at ANY desired height or angle)
- End Caps (for capping end wall runs or window/door openings)
- Height Adjuster Forms (enabling the adjustment of form stacking to an incremental height difference of 76 mm or 305 mm if required to suit an application)
- Factory Cut Radius Forms (which are factory cut to suit any custom installation, enabling the construction of Nudura forms for ANY desired plan radius formation)

In addition to the above core products, Nudura also has over 30 accessory products to enhance the already state of-the-art form system. A list of these accessories is available in Chapter 5 of this manual.



This manual covers off installation methods with Nudura´s ICF Series of products. Nudura offers other innovative series (One Series, Plus Series and Integrated Series) that complement and enhance the Nudura ICF Series. For more information on the above series visit nudura-europe.com.

NUDURA ICF SERIES

The Nudura ICF Series is the leader in insulated Concrete Form Innovation and Technology and offers users the ability to combine a variety of products during the building process. The Nudura ICF Series offers unique advantages over other products currently on the market.

DURAMAX Technology®
DURAFOLD Technology®
DURALOK Technology®
The 4-Way Reversible System

ONE SERIES

The One Series is the industry's only multi-link form system that enables the creation of a fully exposed concrete surface that extends to the face of a standard Nudura form panel. This offers builders and architects unmatched versatility for projects designed to use ICFs. At the core of this innovative line is our DURA MULTI-LINK™, a newly designed web that enables the builder to create custom multisided form combinations for a variety of commercial and residential building projects.

PLUS SERIES

The Plus Series product line introduces an innovative way for designers and engineers to build their own U-value. Comprised of two new products, the Plus Form and the U-Value Plus+ Insert, this product line offers the ability to optimize U-Value with thermal mass to provide significant energy savings for building owners. The Nudura Plus Series allows professionals the ability to meet new installation requirements with one product.

INTEGRATED SERIES

The Integrated Series from Nudura combines building envelope products that work in conjunction with our line of Insulated Concrete Forms to provide maximum energy efficiency. Each Integrated Series product has been manufactured to install quickly and efficiently and replaces many traditional forms of insulation products that are far more labour intensive.

To download the most up to date version of the Nudura Product Guide go to nudura-europe.com/brochures.

2.0 Getting Started

To help ensure a project starts on the right foot, in this section, Nudura has compiled some helpful tips to help guide your building design, contract documentation, basic structural analysis, layout and elevation planning, estimation techniques and formulae and finally requirements for a typical permit submission involving Nudura product as well as tips on pre-construction planning specific for a Nudura building site. Following these steps should help to avoid delays when submitting your documents for building permit approval, and start your project on its way to a smooth and efficient build.

The permit applicant is ultimately responsible for communicating with, and ensuring that, the building department has the required information to process and issue a permit for a proposed project.

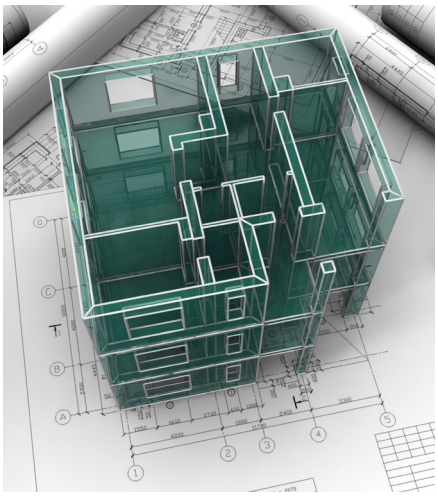


Figure 2.01

2.1 DRAWING & CONTRACT DOCUMENT PREPARATIONS

A smooth permit submission starts with the project drawings. Whether the project is starting from scratch in planning for use of Nudura or you are converting a drawing set from conventional construction to Nudura, the building official will need to see sufficient documentation to corroborate that Nudura is being used on the project and how it is specified and detailed.

First, determine the size and scope of your proposed building design and prepare your drawing set to reflect the fact that the building is being constructed using Nudura. Nudura's experience has shown that there is nothing that gets a Building Official more incensed than a contractor or designer attempting to substitute a building system or component on a set of plans or building site that has not been properly referenced or documented on the permit application documents. Here are a few guidelines on what to include that will help the Building Official be more accepting of the submission documents:

(a) Notes on the basement floor plan, either stand alone or indicating by arrow, to the foundation wall:

- The Form Unit Core Thickness proposed for the installation
- The Horizontal Bar Diameter and required o/c spacing (per the Governing Code Data, Nudura Structural Data or Evaluation Report, usually o/c 457 mm or at floor levels and every other course at minimum if permitted by code)
- The Vertical Bar Diameter and required o/c spacing (reference back to the design tables for the local region– below grade)
- Indicate that the vertical steel will project 500 mm to 600 mm above the first pour to connect into the main level wall cavity
- Indicate the foundation starter bar size and spacing based or specification on local regulations

(b) Notes on the main and any subsequent floor plan either stand alone or indicating by arrow to the exterior walls:

- The Form Unit Core Thickness
- The Horizontal Bar Diameter and required spacing (usually o/c 457 mm or reference the tables for the local region or Evaluation Report)
- The Vertical Bar Diameter and required spacing (reference the tables for the local region or Evaluation Report)
- Indicate how the floors will be attached to the Nudura wall. If a second floor is required, indicate that the vertical steel will project between 508 mm and 610 mm above the first pour to connect into the 2nd level wall cavity
- Indicate the roof truss sill anchor bolts diameter & spacing if required

(c) For all floor plans (including foundation plan), indicate at each window the required specifications for the lintels intendedto be installed. These will include:

- The number, and diameter of the bottom horizontal bars in the lintel
- The link end distance (LED - the distance in from the edge of the opening that the links start). Refer the Building Official to the installation manual diagram or perhaps staple a copy to the drawings to show the lintel cross section
- The link spacing back to the jamb from the LED
- The overall height of the lintel
- Indicate on the plan with a dashed line (i.e. _____ _ _____) the fact that the bottom and top horizontal steel of the lintel extends beyond the edge of the openings as per specification
- As an alternate to including the above notes at each window, a lintel schedule which the openings can be referenced to can be created, similar to a Window Schedule Layout. This method of notation is preferred

2.1.1 GUIDELINES FOR REINFORCING STEEL DESIGN AND PLACEMENT

In preparing drawings under most building codes, Nudura is classified as a "Flat Wall ICF System" meaning that it enables the creation of flat monolithic structural reinforced or plain concrete walls contained within the form system.

HOW NUDURA STEEL PLACEMENT DIFFERS FROM CONVENTIONAL POURED WALL REINFORCEMENT DESIGN

In considering flat wall design using Nudura Insulated Concrete Forms, it is best to consider the wall in exactly the same manner as all performance based building codes do – it is simply a structurally reinforced monolithic flat concrete wall with insulation mounted to both sides of the poured wall.

1. MINIMAL TIE WIRING. Though selected details of steel tying may be required at custom column or beam installations or around openings, the primary assembly of steel occurs without the use of tie wiring. Instead, Nudura relies on features built into its web or cross tie design to enable the wall to be constructed by relying on the "Non-contact Lap Splice" method of reinforcing for both horizontal and vertical steel placement as is provided per local codes and regulations. Under most code bodies all non-contact lap splices installed must be lapped a minimum lap splice length of 40 times the bar diameter. This falls under the applicable concrete codes for monolithic concrete walls which this distance is based on requirements for bundled bars laps in flexural members as per local codes and regulations. In addition, the lapped bars must not be positioned greater than 8 x bar diameter to a maximum separation of 150 mm.

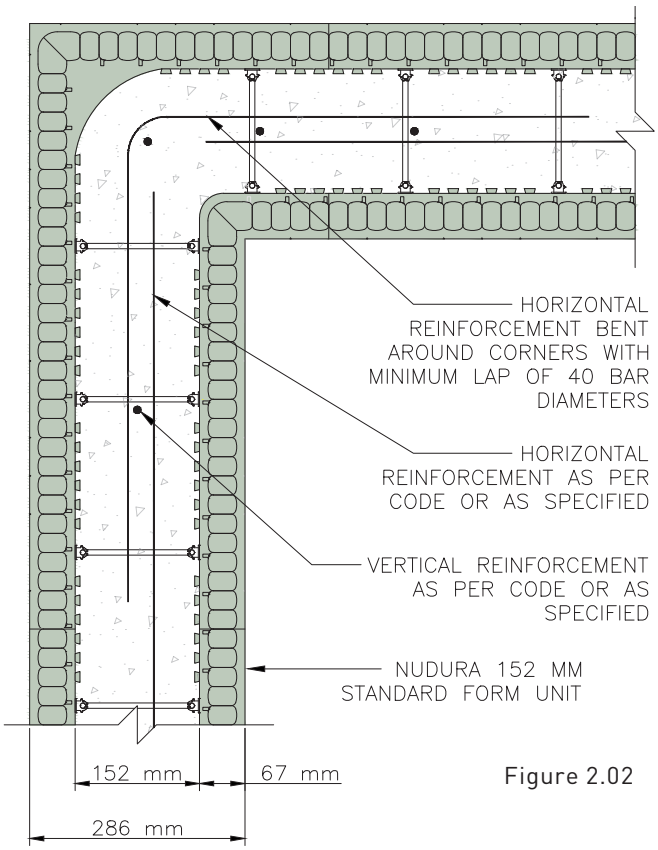


Figure 2.02

2. ORDER OF STEEL PLACEMENT. Unlike traditional forming, where the steel grid is cross wired together prior to the final form face being installed, Nudura wall reinforcing steel proceeds with placement of HORIZONTAL steel being laid in, in non-contact splice fashion, course by course as the form units (or blocks) are installed around the wall in bond stacking fashion. Corners and T form Wall connections, again, will normally feature non-contact lap splice connections (unless specific requirements of the design parameters for a local condition would dictate otherwise). VERTICAL steel placement then proceeds once coursing heights have reached either the top of each floor height of wall being installed (in multi-story installations) or (in the case of a staged single story tall height wall pour) at the designated termination drop height as dictated by the engineer (typically between 2.4 m and 3.6 m in height. In these instances, the steel is cut by the installer to ensure a 40 times bar diameter non-contact lap splice with the level of floor being installed above it.

3. NO TIE WIRING AT FOUNDATIONS. Again, as adopted within most building codes, the foundation dowels are in place to resist lateral movement at the base of the wall section through the installation of wet set dowels which extend from the foundation into the base of the wall to be installed over it. The assembly order of the vertical steel requires that they be placed AFTER the wall is installed to full floor course height. This also dictates that there is NO requirement for the contractor/installer to provide tie wiring of the vertical steel to the foundation dowels. Hence, a non-contact lap splice between the foundation dowels and the wall steel is required at this junction.

HORIZONTAL STEEL PLACEMENT METHOD

Nudura's unique web design allows the contractor/installer the ability to precisely locate reinforcing steel within the wall cavity, ensuring the rebar stays in the optimal required location, thus maximizing the strength of the complete concrete wall. (See Fig. 2.04) This is enabled by notches or capture lugs that are molded into the top and bottom of each cross tie connecting web, which allows the contractor/installer to accurately install the horizontal reinforcement bars within the concrete core in accordance with the Engineer's specifications. This eliminates the requirement of tie wiring the horizontal reinforcement bar
in the correct location specified by the Engineer (in fact, enabling placement as close as 20 mm from the inside face of the form). This improves overall strength performance of the wall assembly which gives the design professional the comfort level of knowing the reinforcing steel has been cast in exact locations as specified.

NOTE: In the diagram (Fig. 2.04), for a 152 mm core form, there are 4 pairs of horizontal steel capture lugs per connection web, each of the lugs being positioned approximately 20 mm apart. This design feature is typical across the form line design for each cavity width of form available - with the wider forms providing more options for steel placement as space permits. The 20 mm gap is the secret to enabling vertical steel to be installed once course installations are completed (see Vertical Steel Placement Method under this Section).

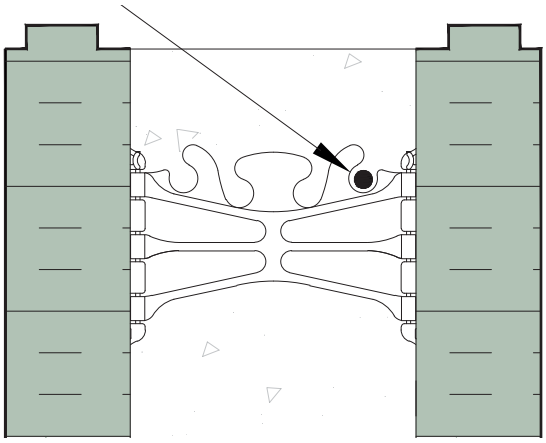


Figure 2.04

HORIZONTAL STEEL SPECIFICATION TIPS

- Nudura forms are manufactured to a course height of 457 mm. Therefore, for efficient on-site installation, always specify horizontal reinforcing at no denser a placement than 457 mm o/c. (Adjust vertical reinforcing density so that this 457 mm module can be maintained horizontally).
- If EXTRA horizontal reinforcement should be required (i.e. for higher seismic zones), consider moving to a higher diameter bar or – as a last resort, consider specifying placement of bar at the top AND bottom of a form unit.
- As per installation instruction, detailing would typically show the horizontal reinforcing oscillating from one lock position (of the pair of reinforcing steel cradles) to the other between horizontal lap splices. As installation proceeds up the wall, the installer will install the steel in the course immediately above in exact opposite positioning of the course below, in such a way that at every course (every 457 mm), horizontal bar will be capturing either one side of the vertical steel or the other as per positioning specification by the engineer (see Figure 2.05a).
- The placement of the horizontal steel can secure the vertical steel in the center and either the tension or compression side of the wall.
- To take full advantage of the accuracy of steel placement, the engineer may detail horizontal steel placement to position the vertical steel to occur:

  (a) Towards the tension (usually towards the "inside" of a below grade wall)

  (b) Towards the outside (tension side) of a foundation wall containing back fill higher than the prevailing grade around it or if installed as a non-laterally supported retaining wall

  (c) To the center of an above grade wall anticipating wind loading from multiple directions (as shown in Fig. 2.05b)

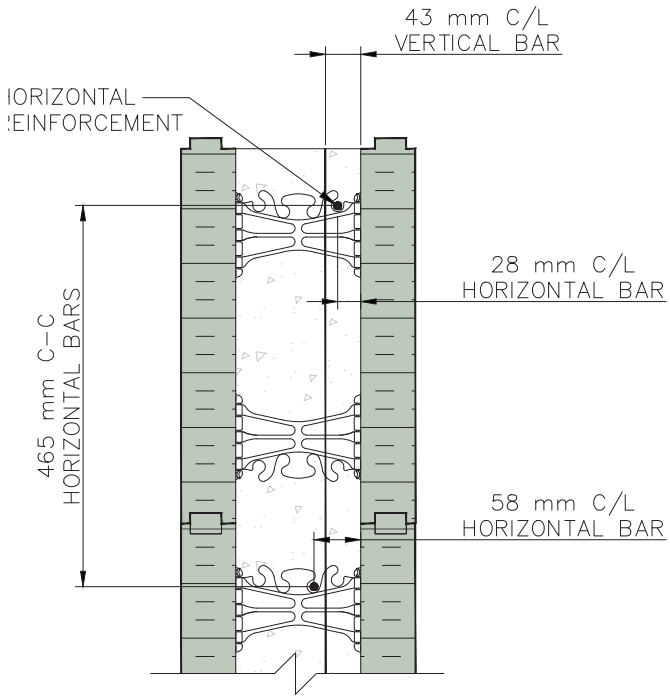


Figure 2.05a

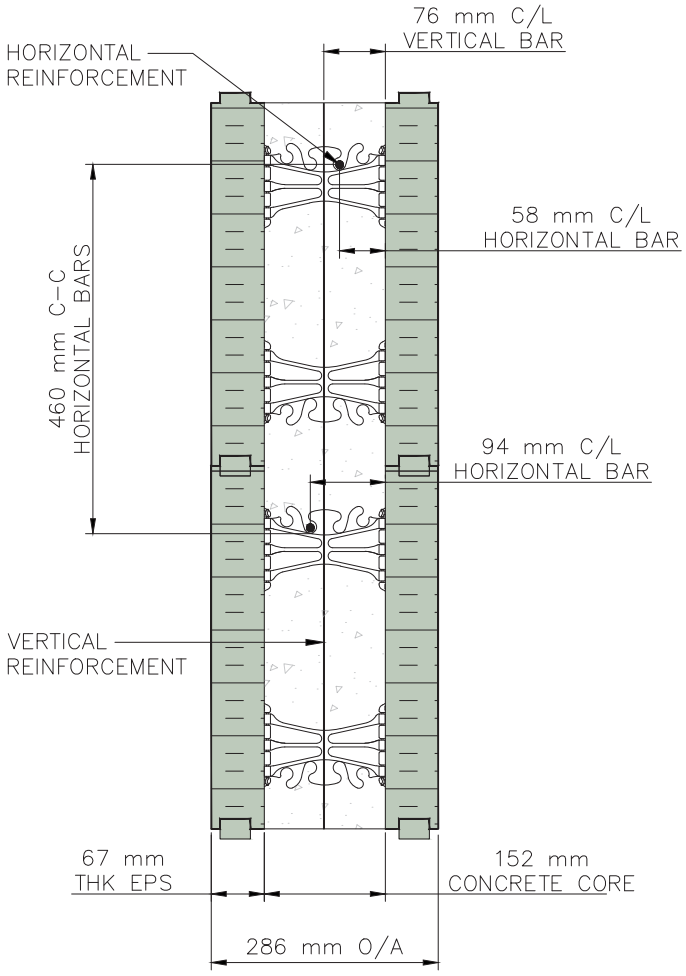


Figure 2.05b

VERTICAL STEEL PLACEMENT METHOD

Nudura's cross connecting web ties are preformed into the EPS panels at 203 mm o/c increments. To optimize vertical steel placement, a Nudura Trained Installer is instructed to do 3 things:

(a) Ensure that the forms are placed with ALL webs being in vertical alignment with each other.

(b) Feed vertical steel downward into the wall such that it will be WOVEN into the central 20 mm gap that is formed by the oscillating placement of the horizontal steel courses (as noted above)

(c) Install vertical steel so that it occurs adjacent to a web on the side from which concrete is intended to be first placed into the wall. This means that as the concrete pushes against the vertical steel, the pressure of the concrete will drive the steel against the web and the web will prevent the vertical steel from moving out of alignment during the pour (hence, no tie wiring required)

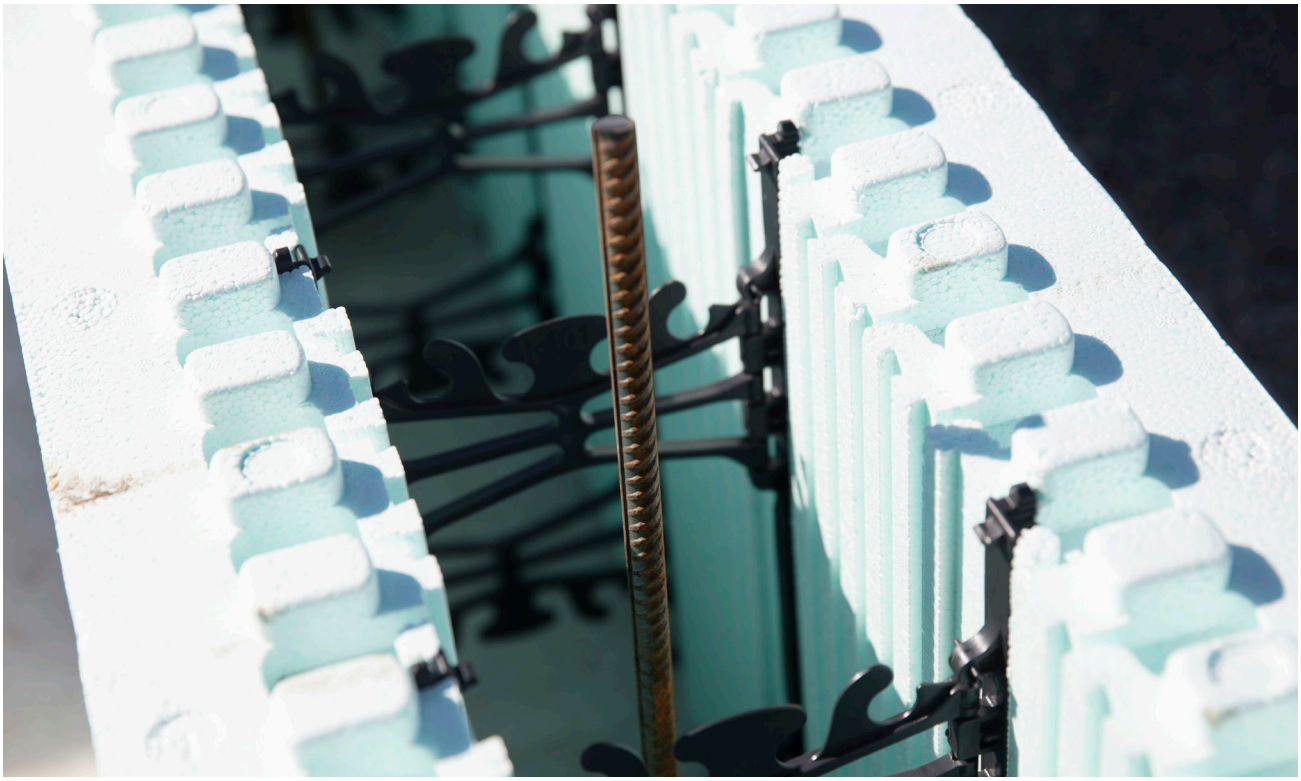
By following the vertical steel specification tips given below, the design professional will guarantee that the installer will be able to best optimize accurate and rapid steel installation within the Nudura wall system.

VERTICAL STEEL SPECIFICATION TIPS

Using the above installer techniques as a guide, remember that reinforcing steel proceeds MOST efficiently if specified on vertical grids that are multiples of 203 mm on center. (i.e. 203, 406, 610, 813, 1016, 1219 mm o/c).

If the design calculation requires vertical steel at increments not within the 203mm spacing of the web, Nudura recommends that the designer consider doubling every other reinforcement bar or to vary the bar diameter. This achieves the same required cross sectional area of steel in order to meet the design specifications.

When dealing with a cold joint, it is recommended to wet set dowels into the concrete as deep as 40 times the diameter of the reinforcement bar using a non contact lap splice. This will facilitate an easier in-field build than more traditional methods which require joint level access for tie wiring. Always remember that vertical steel is placed AFTER the wall is constructed to the designated construction height and prior to concrete placement.



2.1.2 LAYOUT PLANNING USING NUDURA FORMS

In the move from traditional wall systems to the use of Nudura Integrated Building Technology in the construction industry, there are important elements for the contractor/installer to consider especially with respect to plan layouts.

First and foremost is the overall wall thickness. Unlike many other traditional walls, the exterior/interiour face of a Nudura wall is a minimum of 67 mm from the concrete core it contains. Therefore, if an engineer specifies the exterior limit of his structure relative to a grid line, ensure that the architectural detail and plan always reflects that the exterior of the building is located such that the exterior insulation will lie outboard of the grid line, clear of this element.

Appendix A of this manual contains the form unit profiles for each unit available in the Nudura lineup. Although each form in Appendix A is shown with a 152 mm concrete core, alternative core thicknesses are available and details for each of these can be obtained from Nudura through your local distributor. The geometry of the 90º, 45º and T Form Unit profiles strongly dictate the dimensions that will follow for "Nudura Friendly" layout dimensions. These dimensions are based on 3 very important rules of on-site installation which are as follows:

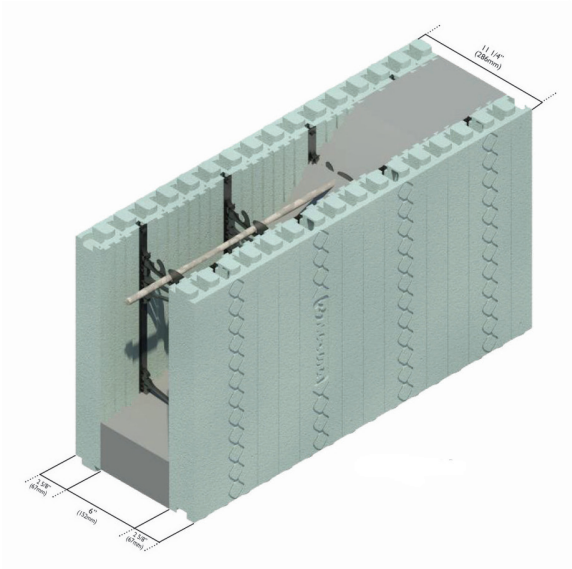


Figure 2.10

1. Both corner units (45º and 90º) and T form Units are formed so that they can be bond stacked, course on course, with each other to create an ideal 406 mm overlap with the interfacing standards. This practice encourages consistency from course to course and maintains maximum strength in the construction of the wall for handling concrete pressures.

2. To maintain the geometry in Point 1 above, this manual teaches installer/contractors to avoid cutting corners or T Form Units, hence the layout tables reflect this philosophy. Only when designers require tight corner changes will the contractor/installer entertain cutting a corner form unit to achieve an in-field build. The reason Nudura tries not to cut the corner forms is that under concrete pressure is increased pressure in these areas. This practice also better maintains an ideal offset of 406 mm when the corner forms are reversed on successive course placement, as shown in Figure 2.11.

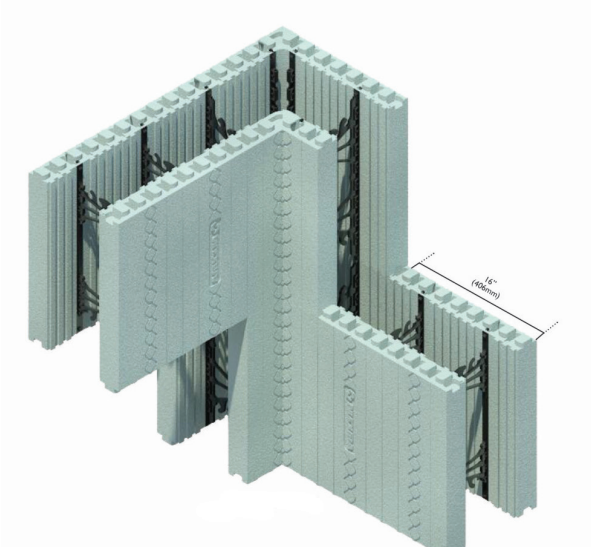


Figure 2.11

3. The standard forms that are assembled within each course between the corners and T form units work best if the cut length of form occurs in multiples of 203 mm. This assures that the vertical interlock of the webs will be maintained everywhere throughout the wall height. This is ideal for both the contractor/installer and the end user in that, at every location, the webs are assured to be in-line for drywall and other finish attachments both interior and exterior. This also allows the building owner or occupant to know where fastening is possible for the anchorage of decorative and storage elements. It should be noted that the wall can, if necessary, be constructed to ANY dimension required by the designer. However, optimum layouts will result best if the 203 mm) increment recommendation is followed.

IMPORTANT NOTES REGARDING APPLICATION OF "Nudura FRIENDLY" DIMENSIONS

Though a designer may use this information to ensure the most optimal design for Nudura form units possible, there are factors to be considered in the planning and final installation of the product in-field:

Not every designated wall of a Nudura plan layout can be designed to be optimally laid out to "Nudura Friendly" dimensions. This is definitely true for building layouts where there are odd numbers of outside or inside corners. In such cases, ONE of the intersecting dimensions to the odd corner MUST be sacrificed to meet the optimal layout condition. The non-conforming plan dimension can simply be indicated on the plan to alert the in-field contractor that one of the walls intersecting this corner will have to be custom built with a smaller than 203 mm increment.

In the perfect world of computer aided design, dimensional layouts are always exact. Despite the intent of achieving perfect Nudura dimensioning, the designer and contractor should bear in mind that ICF products being formed with EPS foam are subject to minor product dimensional tolerances that must be taken care of in the final in-field build. While Nudura quality control processes strive to achieve tolerances within +/- 3 mm, form unit length tolerances can vary by as much as 3 mm shorter or up to 9.5 mm longer on an 2.44 m standard form as a result of variances in, EPS bead type, EPS pre-expansion levels, bead aging time, manufacturing plant humidity and temperature at time of molding, and rate of post-mould shrinkage. Generally the product is rarely on the high or low end of these tolerances. Nudura's manufacturing facilities take great pride in ensuring that all products produced maintain a constant dimension. However, both designer and contractor/installer must be ever mindful that accommodation of this factor may, at some point in time, have to be made in the final installation.

CORNER TO CORNER FORM LAYOUT SCENARIOS

On the basis of the key assumptions noted above, Nudura has created layout tables for every core thickness of form offered, for planning scenarios, involving each of the wall profile intersections noted below. The number of tables necessary to cover scenarios by reference table for wall lengths up to 15.24 m is too numerous to publish in hard copy here. However, should the contractor/installer need a copy of these tables, please contact the local distributor.

Figure 2.12 is a typical example of how to use these tables to quickly identify the closest "Nudura Friendly" dimension for the condition required for each wall segment of the proposed plan layout. In the instructions in each case remember that the scenarios given at the start of the tables indicate dimensions achievable if, and when, field condition demands that the corner form be cut.

RADIUS WALL SCENARIOS

Radius walls are formed simply through the use of Nudura's straight 2.44 m standard form unit panel system coupled with Nudura's cross linked insert webs. The contractor/installer does not need to worry about perfect configuration of "Nudura Friendly" dimensions for radius wall designs since coordination of in-field construction is largely handled through the custom radius cuts that are made at the factory. Nudura has developed a simple Radius Wall Calculation Spread Sheet which assists the contractor/installer and designer in knowing what lengths of form cuts will be made by the computer program at our plant to facilitate the cutting of the segments to construct a radius wall.

2.1.3 WALL HEIGHT CHARTS

Nudura's form heights do not always need to be considered for elevation design layout. Contractor/installers working regularly with the Nudura Wall System will plan stack heights to suit the elevation layout requirements of the building as assigned by the architect or designer, no matter what this may be. However, if the designer requires optimum conditions for ease of construction of Nudura on site, here is a list of tips to remember for achieving optimum design for installation of Nudura forms:

- Avoid using height adjusters or use them sparingly. Using height adjusters will add to the labor cost due to the fact that they are 813 mm in length by 76 mm high. The man-hours/m^2 will increase significantly for this area of the wall. Therefore, if floor heights can be coordinated with the design to avoid use of height adjusters, this will serve to make the project more cost efficient.
- If a half form will achieve optimum stack height within the projected wall assembly from top of foundation to parapet or roof line, plan to use the half height form at either the foundation or the top of the wall or roof line. Do NOT specify half height forms at any portion of a continuous stack height as this will cause additional form support to have to be added by the installer prior to concrete placement.
- When planning complex details, always remember that if full height hinge pin web forms are being used, the crucial structural hinge pin ties that connect the panels together start at 50 mm from the top and bottom of the form and are each 76 mm in height. Avoid any detailing that will require the installer to cut the form in this region. If this is unavoidable, be sure to detail it as an insert web form and the installer will order and install accordingly, and will detail the web connections to handle the condition of bearing accordingly.

METRIC DIMENSION WALL HEIGHT CHART

Table A

No. of Courses	Standard Form Height of Wall (meters)	Plus One 7.2 mm High Height Adjuster (meters)	Plus One 152 mm High Half Optimiser (or cut standard (meters)	Plus One 229 mm High Half Standard (meters)	Plus One 305 mm High Optimiser Form (meters)	Plus One 381 mm High Segment (meters)
1	0.457	0.533	0.610	0.686	0.762	0.838
2	0.914	0.991	1.067	1.143	1.219	1.295
3	1.372	1.448	1.524	1.600	1.676	1.753
4	1.829	1.905	1.981	2.057	2.133	2.210
5	2.286	2.368	2.438	2.514	2.590	2.668
6	2.743	2.820	2.895	2.971	3.047	3.125
7	3.201	3.277	3.352	3.428	3.504	3.582
8	3.658	3.734	3.809	3.885	3.961	4.040
9	4.116	4.192	4.266	4.342	4.418	4.497
10	4.573	4.649	4.723	4.799	4.875	4.955
11	5.030	5.106	5.180	5.256	5.332	5.412
12	5.488	5.564	5.637	5.713	5.789	5.869
13	5.945	6.021	6.094	6.170	6.246	6.327
14	6.403	6.478	6.551	6.627	6.703	6.784
15	6.861	6.936	7.008	7.084	7.160	7.242
16	7.317	7.393	7.465	7.541	7.617	7.699
17	7.775	7.850	7.922	7.998	8.074	8.156
18	8.232	8.307	8.379	8.455	8.531	8.614
19	8.690	8.765	8.836	8.912	8.988	9.071
20	9.147	9.222	9.293	9.369	9.445	9.529
21	9.604	9.679	9.750	9.826	9.902	9.986
22	10.062	10.137	10.207	10.283	10.359	10.443
23	10.519	10.594	10.664	10.740	10.816	10.901
24	10.977	11.051	11.121	11.197	11.273	11.358

Note: The 381 mm segment can be achieved by cutting a Standard Form or using Optimiser Form and one Height Adjuster.

2.2 ESTIMATING

2.2.2 METRIC FORMULA

NUDURA material requirements for any project can easily be determined manually through the simple calculations within this manual. In all cases the estimator must collect the following information from the plan in order to ensure the estimate is accurate.

Total linear meters of perimeter _____

Total # of 90° corners _____

Total # of 45° corners _____

Total # of T connections _____

Total linear meters of tapered top form _____

Total linear meters of brick corbel form _____

Total linear meters of brick corbel extension _____

Height of the wall _____

Total # of courses _____

Total linear meters of height adjusters _____

Total linear meters of optimizer _____

Total # of courses of height adjusters _____

Total linear meters to be waterproofed _____

Total height to be waterproofed _____

Total linear meters to be rendered _____

Total height to be rendered _____

Total m² of openings (width x height) _____

Total linear meters of opening width _____

Total linear meters of opening height _____

Wall cavity thickness _____

The estimator will need to take the total lineal meterage of the building and add 0.61 m for each inside 90° corner and 0.31 m for each inside 45° corner on the footprint.

This chart enables an estimator working in metric dimensions to easily summarize the necessary information regarding total opening width and height for estimating cavity closure material along with the total m² of openings there are in the building. These totals will be used in estimating formulas further on in this section.

Table B

DIMENSION OPENINGS SUMMARY CHART				
OPENING #	QUANTITY	X WIDTH	X HEIGHT	= TOTAL M^3
TOTALS				

TO CALCULATE THE STANDARD FORM UNITS:

- Gross Wall Area (m²) = Total Linear meterage of wall (m) x Total Height (m)
- Net Wall Area (m²) = Gross Wall Area (m²) – Total area of openings (m²)
- Total Standards/course = (Total Lineal meters of wall – (# 90° Corners x 4) – (# 45° Corners x 3)) ÷ 2.44
- Total Standards before deductions = Total Standards/course x # of courses

If brick corbel, taper top, or T forms are needed for the building they need to be subtracted off the total standards calculated above.

- Standards (BC) = Lineal meters of Brick Corbel ÷ 2.44
- Standards (TT) = Lineal meters of Taper Top ÷ 2.44
- Standards (OP) = ((LMOP x # COP) ÷ 1.219) ÷ 3
- Standards (TF) = (# of T Forms x # of courses) ÷ 0.61
- Total Standards = Total Standards before deductions - Standards (BC) - Standards (TT) - Standards (TF)

TO CALCULATE THE NUMBER OF 90° CORNER FORMS:

- 90° form = #90 x #C

This formula multiplies the number of 90° corners by the number of courses. M^3

TO CALCULATE THE NUMBER OF 45° CORNER FORMS:

- 45° form = #45 x #C

This formula multiplies the number of 45° angles by the number of courses.

TO CALCULATE THE NUMBER OF T-CONNECTIONS:

- T connection = #T x #C

This formula multiplies the T connection by the number of courses.

TO CALCULATE THE NUMBER OF BRICK CORBEL FORMS:

- BCF = Linear Meters ÷ 2.44

TO CALCULATE THE NUMBER OF BRICK CORBEL EXTENSIONS:

- BCE = Linear Meters ÷ 0.82
  # of Screws = BCE x 6

TO CALCULATE THE NUMBER OF OPTIMIZER FORMS:

- OP = (LMOP x 2 x #COP) ÷ 1.219
  OPTIES = (OP ÷ 2) x 6

TO CALCULATE THE NUMBER OF HEIGHT ADJUSTERS:

- HA = (LDHA x #CHA x 2) ÷ 0.8128
  HA Ties = (HA ÷ 2) x 4

TO CALCULATE THE NUMBER OF ROLLS OF WATERPROOFING:

- WP = LMWP x HWP ÷ 19.5

A roll of waterproofing is 21 m^2 but the wall coverage is 19.5 m^2. This allows for a 76 mm overlap at the edges of the membrane.

TO CALCULATE THE NUMBER OF BAGS OF RENDER MIX:

- PC = LMPAR x HPAR ÷ 6.97

This is the average coverage obtained per bag for a two coat application.

TO CALCULATE THE NUMBER OF FIBER MESH ROLLS:

- FM = LMPAR x HPAR ÷ 44.1

A roll of fiber mesh is 44.1 m^2 An allowance for overlap may be required depending on the application techniques.

TO CALCULATE THE QUANTITY OF WALL ALIGNMENT SYSTEM:

- WAS = Linear Master + 1 per corner and T intersections ÷ 1.2

TO CALCULATE THE AMOUNT OF REBAR:

How to Determine the Required Reinforcing Steel to Wall Area "Ratio"

The ratios shown in table C have been calculated by totaling the bar length specified for each scenario then dividing this length by the total square meterage of wall area that encompasses these bars. Using this method, a ratio can be specified for both vertical and horizontal mats of steel separately (if they are different diameters from each other) Or if both mats are the same diameter of steel, the ratio can be specified as a "Combined Steel Mat".

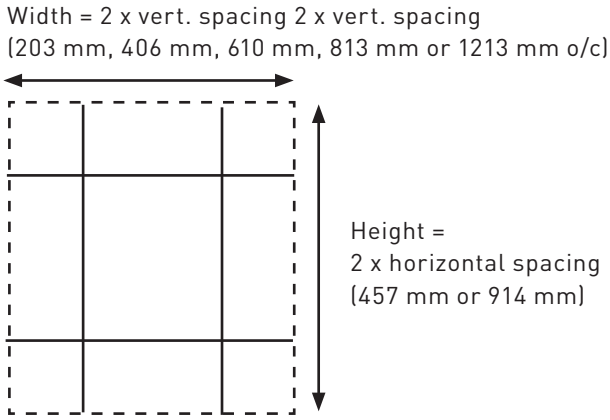


Figure 2.13

REBAR = LMPER x HW x MULTIPLIER (Table C)

The linear meter of the wall is multiplied by both the height of the wall and by value obtained in table C which is a constant. The result is in meters. This constant is for a rebar grid in the wall 0.457m x 0.406m horizontally and vertically respectively with an allowance for horizontal splices.

Table C

	Vert. o/c Spacing (in.)	Horiz. o/c Spacing (in.)	Ratio LF/ SF of Wall Single Mat	Ratio LF/ SF of Wall Double Mat
Vertical Only Steel Mat	203	-	4.92	9.84
	406	-	2.46	4.92
	610	-	1.64	3.28
	813	-	1.25	2.50
	1213	-	0.82	1.64
Horizontal Only Steel Mat	-	457	1.08	2.16
	-	914	7.12	14.24
Combined Steel Mat	203	457	5.48	10.96
	203	914	4.36	8.72
	406	457	3.84	7.68
	406	914	2.72	5.44
	610	457	3.41	6.82
	610	914	2.33	4.66
	813	457	3.02	6.04
	813	914	1.90	3.80
	1219	457	4.92	9.84
	1219	914	3.28	6.56

TO CALCULATE THE VOLUME OF CONCRETE

- m^3 of CONCRETE = LMPER x HW x Concrete Multiplier (Table D)

The concrete multipliers shown in table D (below) are constants, each of which represent the total volume of concrete (in cubic meters) that is necessary to cover 1 square meter of wall area for the specified core thickness of form. To calculate the amount of concrete required to fill the wall, simply multiply the total area of the wall (in square meters) by the multiplier shown for the selected core thickness of form. The volume of concrete ordered should be reduced in accordance with window and door openings. If using a concrete pump as a method of placement, an allowance must be included within the calculated volume of concrete to account for waste.

Table D

Concrete Core Size	Concrete Multiplier
102 mm	0.102
152 mm	0.152
203 mm	0.203
254 mm	0.254
305 mm	0.305

TO CALCULATION THE NUMBER OF VERTICAL JOINT CLIPS:

- VJC = (LMPER ÷ 2.44m x 4 per standard x # of courses) + (# of Corners x 4 x # of courses)

The VJC formula takes the lineal meterage of the perimeter of the structure and divides by the length of a standard form. Then multiply this by 4 per standard form and then multiply again by the number of courses. The second part of this formula then takes the number of corners and multiplies by 4 clips per corner and then multiplies by the number of courses.

Note: Remember that what is in the brackets must be completed before adding them together for the total number of clips.

ESTIMATING FORMULAE SUMMARY (METRIC)

- **STANDARD FORM UNITS:**
  - Gross Wall Area (m^2) = Total Linear meters of wall (m) x Total Height (m)
  - Net Wall Area (m^2) = Gross Wall Area (m^2) – Total area of openings (m^2)
  - Total Standards/course = (Total Lineal meters of wall – (# 90° Corners x 4) – (# 45° Corners x 3)) ÷ 2.44
  - Total Standards before deductions = Total Standards/course x # of courses
  - Standards (BC) = Lineal meters of Brick Corbel ÷ 2.44
  - Standards (TT) = Lineal meters of Taper Top ÷ 2.44
  - Standards (OP) = ((LMOP x # COP) ÷ 1.219) ÷ 3
  - Standards (TF) = (# of T Forms x # of courses) ÷ 0.61
  - TOTAL STANDARDS =
    Total Standards before deductions - Standards (BC) - Standards (TT) - Standards (TF)
- **90° FORM UNIT:** 90° FORM = #90 x #C
- **45° FORM UNIT:** 45° FORM = #45 x #C
- **T FORM CONNECTIONS:** T FORM = #T x #C
- **BRICK CORBEL FORM 2.44m UNIT:** BCF = LMBCF ÷ 2.44
- **BRICK CORBEL EXTENSION:** BCE = LMBCE x .375
  # of Screws = BCE x 6
- **OPTIMIZER FORM UNIT:** OP = (LMOP x # COP) ÷ 1.219
  OP Ties = OP x 6
- **HEIGHT ADJUSTER:** HA = LMPER x .75 x #CHA
  HA Ties = (HA ÷ 2) x 4
- **WATERPROOFING:** WP = LMWP x HWP ÷ 20
- **RENDER COAT:** RC = LMRC x HRC ÷ 7
- **FIBER MESH:** FM = LMFM x HFM ÷ 44
- **WALL ALIGNMENT SYSTEMS:** WAS = LMPER + 1 per corner or tees ÷ 1.2
- **REBAR:** REBAR = LMPER x HW x MULTIPLIER (Table 2.2.2.1)
- **CONCRETE:** Concrete = LMPER x HW x Concrete Multiplier (Table 2.2.2.2)
- **VERTICAL JOINT CLIPS:** VJC = (LMPER ÷ 2.44m x 4 x #C) + (# of Corners x 4 x #C)

ESTIMATING RADIUS WALLS (METRIC)

For determining total number of radius forms required for on site construction of a NUDURA radius wall or for preparing an order for factory cut NUDURA radius forms, you can use the calculation formula below. This formula assumes that any radius constructed will be an "arc length segment" of a full circle with a known angle of rotation:

The following information is required to determine total number of radius forms for any given radius wall in a floor plan:

1. The Outside radius (measured in millimeters) from the focus point to the outside face of the NUDURA form
2. The inside radius (equals the Outside radius (in millimeters) less the total form thickness being used)
3. The Degrees of Turn of radius (this is total number of degrees of rotation that the radius covers of a full circle)
4. The Total Wall Height (measured in millimeters).

TO CALCULATE THE TOTAL NUMBER OF RADIUS FORMS REQUIRED:

No. of forms per course — No. of courses

No. of Forms = Outside radius (in mm) x 6.283 x (Degrees of Turn of Radius/360) (in mm) X Wall Height

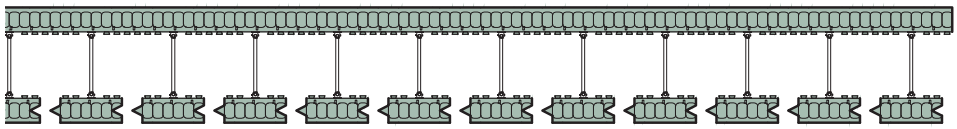
_____ _____

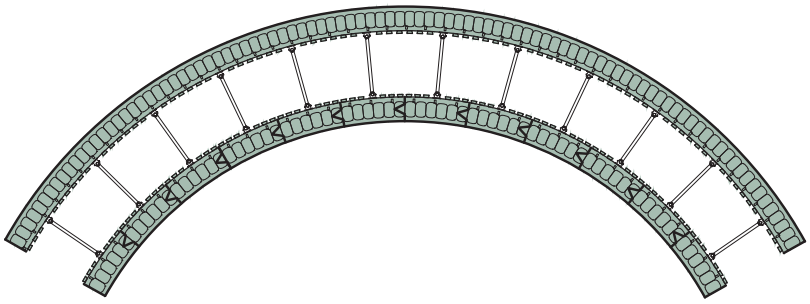
2438 457

NOTES:

1. To assure adequate product for accommodating custom fitting of the wall forms into the standard elements of the plan, the first part of the calculation (no. of forms per course) above should be ROUNDED up to a whole number or (full form length) before multiplying by the number of courses of forms required.
2. Do NOT deduct any allowance for openings particularly if placing orders at the factory for custom radius forms.

As an alternate, you can also obtain NUDURA's radius wall form unit spread sheet calculator through your distributor which enables the same calculation to be performed in Microsoft excel® along with giving the required cut segment lengths. (The distributor can also duplicate the quantity portion of this calculator by entering data into the NUDURA radius wall digital order form).





3.0 Installation Procedures

INTRODUCTION

The purpose of this section of the manual is to give a detailed description of proper installation methods. It is also intended to make sure all the necessary steps are taken to ensure a successful build occurs.

This chapter is laid out similarly to how a typical building is constructed; starting at the foundations and ending with the exterior finishes that can be applied.

3.1 FOUNDATIONS

Foundations are designed to transfer and distribute the loads applied from the building structure without exceeding the safe load bearing capacity of the soil or rock on which they bear.

If you have never worked with Nudura before, when it comes to foundation sizing, always remember that "edge projection distance" is the distance from the concrete wall surface INSIDE the Nudura form to the foundation edge – NOT the exterior wall surface of the EPS foam to foundation edge.

Always check the layout prior to placing tools and material in the work area. At most construction sites, it's usually more efficient to work from inside the perimeter walls. All materials and tools required for the assembly of the wall should be placed inside the foundation.

Care should be taken to have form units accessible where needed while maintaining a 2 m clear distance around the perimeter of the walls to allow room for the alignment system installation discussed later in this chapter. Also a clean, accessible work site will prove to be beneficial both in terms of production and safety.

Figure 3.01

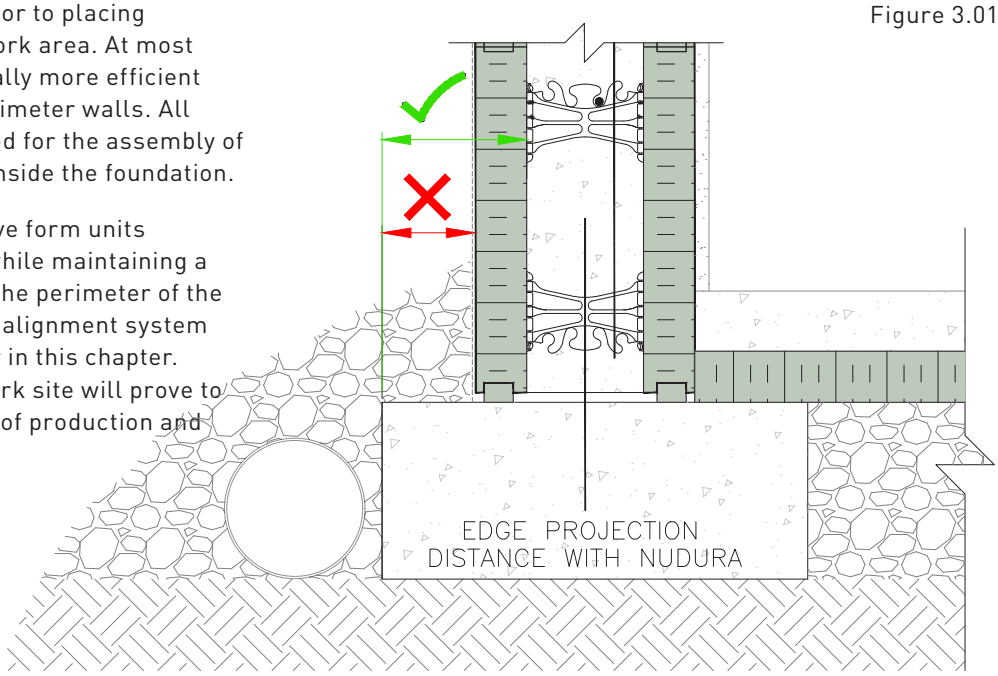


Figure 3.02

Vertical reinforcement dowels provide lateral support at the base of the wall. The dowels serve as a construction joint reinforcing connection and vertical wall steel does not need to be tied to these dowels. Please refer to the local building code for the area of the project to reference the on-center spacing and diameter of bar needed for this connection.

FOUNDATION TYPES (STRIP, SOG, GRADE BEAMS AND PILES, SOLID BEDROCK)

Nudura can be modified to create reinforced structural walls that can rest on basic strip foundations, slab on grade (SOG), and grade beams connected to piles. The forms can also be scribed to bedrock.

Nudura recommends that they be installed to within ± 5 mm of level. This tight tolerance in foundation or slab level is one of the fundamental keys for a quality build. Unlike conventional forming, Nudura forms will need to be leveled following the 2nd course of form placement. By forcing the foundations to be poured within the above noted tolerance, the 2nd course leveling operation can proceed efficiently with minimal need for shimming or cutting the foam to bring the form system to proper level.

Grade Beams can be created using Nudura that can span across, and connect onto, piles driven into the ground. In these situations, an engineer's design is required to ensure the grade beam is reinforced to support the loads being forced upon them.

Whatever a site may dictate such as sites with steep sloping bedrock, the forms can be simply "SCRIBED" and cut to the rock profile to enable seating of the form into its required position directly on top of the bedrock – a feat that is virtually impossible with standard forms or concrete block. Sites like these that are normally impossible for access and convenience are easily handled using Nudura.

Figure 3.03

STEP FOUNDATIONS

If the design will involve step foundations, always remember that Nudura forms are 457 mm in height. Therefore, to avoid unwanted waste in cutting the forms on site, installation works best if the step increments are planned in 457 mm step increments where local codes permit. This ensures that even when the forms are stacked with the lower interlock contacting the foundation, the form unit extending over the step will stack smoothly and lock into position without the need of cutting off the interlocks. (Note: Consult local building codes for maximum allowable step height, and step run.)

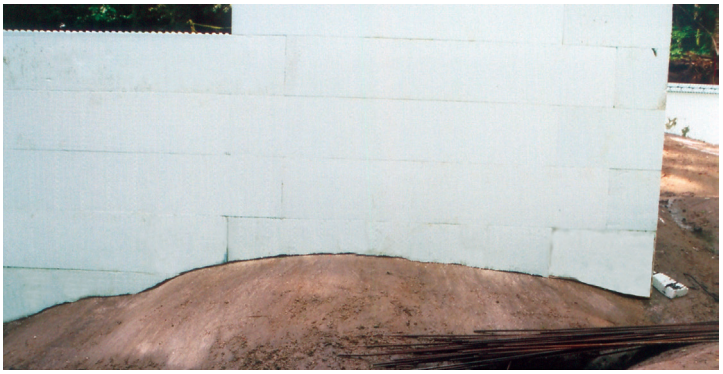


Figure 3.04

The "shoulder", or finished locked surface, of the top or bottom of all of Nudura forms is actually located 12.7 mm above the base of the form when it is set on top of a foundation. This gap represents the depth of each interlock tooth's projection downward below the form shoulder which is also on the top of the unit ready to interlock with the course above it. As stated above, the installers will not cut these interlock projections off since there is no need to, as liquid concrete at a slump of 125 mm to 152 mm cannot succeed in flowing between the interlocks since the spaces are too small.

If stack height planning requires starting coursing with a half height or partial height form unit, the initial step foundation height must take into consideration the fact that once the form unit is cut and reversed around to interlock with the form unit above it the interlock is no longer present as part of the unit height. To ensure that the first course form shoulder occurs properly in line with the bottom shoulder of the second course, simply pre-plan that the first partial height step foundation is exactly 12.7 mm lower than the partial form cut height measured from the cut to the shoulder (or meeting surface) of the form. See Figure 3.06 for illustration of this concept.

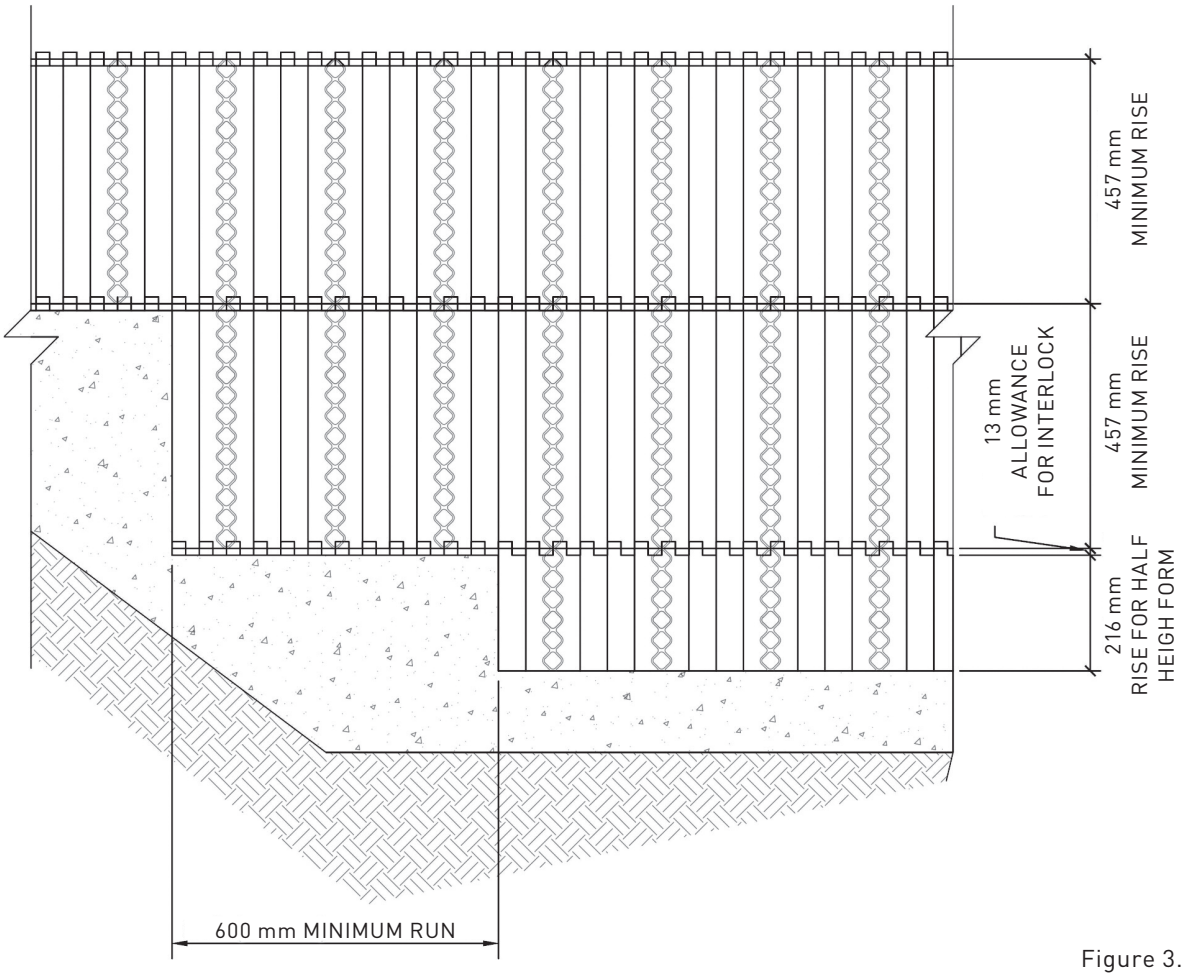


Figure 3.06

3.2 FIRST COURSE PLACEMENT

The foundation or slab area, where the form units are to be installed, should be free of dirt and debris. Special care should be taken during the installation of the form units to keep the wall cavity free of foreign material. (This includes foam fray that will result from cutting the forms). Extra time spent to establish an effective layout/pattern for the form units in the first course will save time on all the successive courses. This can prove to be a good investment of time, as it will save unnecessary cutting of form units and significantly reduce the need for form support.

Nudura recommends starting layout on the longest wall at each corner and working towards the center. Establish a pattern around the perimeter of the building. This practice will result in any cut being close to the center of the wall. Ideally cuts should be made at an opening. It will ensure the webs will always be lined up and locked together making it easier for the trades that will follow to attach other building materials to the fastening strips. Additionally, as stated in the introduction section, having the webs line up will virtually eliminate compression during concrete pour.

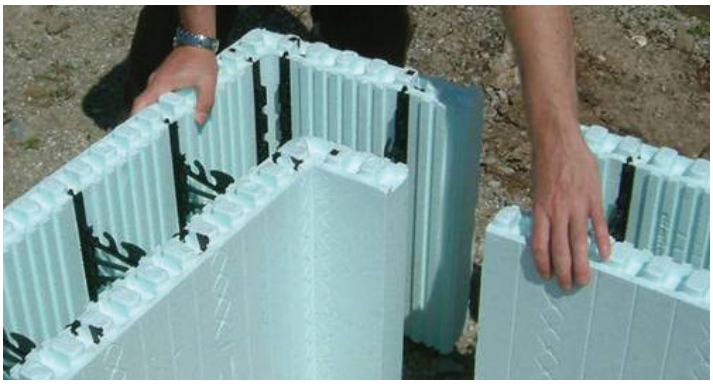


Figure 3.07

Ensure the form units are tight end-to-end to maintain proper dimensions. The vertical joint clips will help ensure the corner and standard forms stay tight end to end. Nudura recommends that for the first course 8 vertical joint clips are used for both the corner and standard forms. If cuts are necessary to complete a wall length, Nudura recommends, where possible, the form unit be cut on one of the cut lines indented in the EPS (expanded polystyrene). The cut lines must be respected to ensure the foam interlock will continue to lock with the next course of form units. When a contractor/installer cuts on the indented lines it will result in the overall building wall dimensions, having a maximum length tolerance of ± 25 mm.

Important Note: If the contractor/installer needs to cut a form with more than 102 mm of EPS extending beyond the last web, additional form support will be necessary to ensure that during concrete placement these areas do not create a problem under pressure.

Strapping can be used to prevent bulging or problems of the EPS under concrete pressure. Simply take a short length of strapping (long enough to extend past the fastening strip on both sides of the area to be reinforced, approximately 51 mm and screw into the fastening strips, as shown in figure 3.08. Typically 2 straps per form height will be required to give sufficient form support. This method must be performed to both sides of the form.

Figure 3.08

Special attention must be given to ensure that the building corners are square when making an adjustment to any wall dimensions. In plan layouts where dimensions are critical to local setback requirements, or specific required interior room dimensions, a "off-cut line" (vertical joint) seam is an alternate method of layout. It should be located near the center of the wall length, if possible at an opening. So long as the off-cut line seam occurs at the same point on all succeeding courses, and is supported with wood strapping at each course, there is no concern posed by the vertical stack joint created since the form fastening strips structurally link with each other. Nudura experienced installers have found that cutting a 900 mm long piece of form lock and installing it into each course helps to keep the joint in line.

Ideally, by following these rules, there should be no need to cut any corner forms and the 406 mm off-set stacking pattern that's established by reverse stacking one corner form over top another will be maintained.

Invariably, however, there will be some plan layouts where wall lengths between corners are so small that either off-cut lines or cutting the corner forms (along with "soldier stacking" of these components) will be necessary in order to complete construction of the wall. In these cases, additional form support will be required.

SPECIALTY ELEMENTS TO BE CONSIDERED AT FIRST COURSE PLACEMENT

Nudura T-WALLS

T-walls can be created using the standart forms and supported using the T-form support strap system.

VERTICAL STACK JOINTS

Sometimes, (particularly for smaller site conditions) a plan design may dictate the need to cut the forms off the guide lines provided on the forms in order to force the final building layout to precisely conform to the floor plan. In this case, a "Vertical Stack Joint" is necessary. A vertical stack joint is completed simply by butting the forms against one another at the vertical seam up the height of the wall. Additional bracing, either internally or externally, will be required to resist concrete pressure in this area. As discussed previously, the installation of a piece of form lock ensures the wall maintains straightness, but additional bracing can also be used to prevent separation of the forms during the concrete pour. Additional internal bracing can be as simple as taking a length of tie wire and wrapping it around the closest webs to the vertical joint, then connecting the wire to it. This procedure needs to occur at both the top and the bottom web of the form and is repeated for every course within the wall height to be constructed. Remember to not over tighten the tie wire as it can put undue pressure on the webs and creates problems during concrete placement. External bracing can be done very simply by taking pieces of wood and screwing these to the fastening strips on either side of the vertical joint, a minimum of two pieces per course will be required.

Figure 3.09

Figure 3.10

RADIUS WALLS

The same consideration for T Walls needs to be given during planning and first course placement for radius walls. The important thing at this stage of construction is to mark where the radius will start and end in its connection with the straight walls that form part of the first course. Identify from the plan, the focus of the radius and mark it accurately onto the slab or foundation, by carefully triangulating its location from adjacent straight walls and/or references from the floor plan. Next, using the radius focus, mark the outside and inside line radii of the wall onto the foundation to the start and end point connections with the straight walls of the plan. Since these connections will typically be butt or mitered joints and will require a vertical stack joint of some type, the radius wall can be constructed independently of the rest of the build. For more details on radius walls refer to the Technical Bulletin.

Figure 3.11

REINFORCING STEEL PLACEMENT

Steel reinforcement shall be installed as per the plans and specifications prepared by a qualified designer. The placement of the reinforcement steel shall conform to local standards, regulations or codes having jurisdiction.

Horizontal reinforcing steel should be installed into the notches (sometimes referred to as capture lugs or cradles) provided in the web, allowing for easy and secure placement. Unless specified otherwise by the designer, horizontal reinforcement is always installed after each course of form units is placed. Nudura recommends alternating the position of the horizontal reinforcing steel from one successive course to another. This practice creates a cage that maintains the alignment of the vertical reinforcing steel which will be installed later. Reinforcing steel is typically placed on the tension side of the wall below grade and in the center of the wall for above grade applications. Typically, the steel arrives to the site in lengths of 6 m, which means that for almost all projects it will need to be spliced together to act as a continuous length of reinforcing steel in a wall. Except for a 102 mm core wall, lap splices are typically installed using "non-contact" lap splices as are provided for under most nationally adopted concrete codes. Lap splice length is typically calculated using the formula of 40 x diameter of wall steel specified.

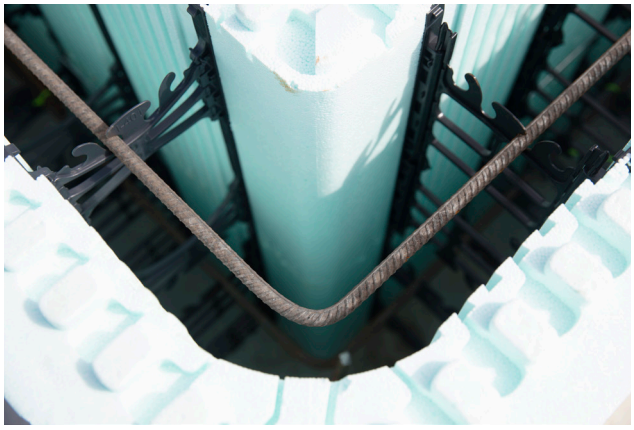


Figure 3.12

PERMITTED SEPARATION OF NON-CONTACT LAP SPLICE LENGTHS

There are two types of lap splices: Contact lap splices (which means the reinforcing steel is touching and needs to be tied), and non-contact lap splices (which means the reinforcing steel can be separated up to 8 x diameter to a maximum separation of 150 mm.

3.3 SECOND COURSE PLACEMENT AND LEVELING

NUDURA recommends that the contractor/installer start the second course at the same corner as the first course, following the same steps of working from each corner towards the center of the wall. When placing the second course corner forms, each corner form unit will be reversed to create an automatic 406 mm offset or "bond" stack with the form units on the first course. Again, remember to align the units in place and press the form unit firmly downward until the web interlocks "snap-lock" together. After the form unit is in place, a rubber mallet can be used to ensure that the interlocks are properly seated tightly together.

Figure 3.13

Additionally, Nudura recommends that in the corners, 4 vertical joint clips are snapped into place locking the corner to the adjacent standard form. Although, as stated earlier, 406 mm is the ideal offset (as established by the corner forms), a minimum of 203 mm staggering of vertical joints should be maintained between courses to ensure that the interlock mechanisms on the end of each web will secure the forms tightly together. Should a vertical joint be less than 203 mm, the contractor/installer will need to add additional form support.

Once the second course of forms has been locked into the first course, the horizontal reinforcing steel will need to be placed within the webs. Remember to offset the bar location by 1 notch (from the corresponding bar in the course below) to ensure the vertical steel can be easily woven between the horizontal steel bars. Additional to the reinforcing steel being placed within the forms, Nudura strongly recommends that a row of form lock now be placed within the cavity of the wall to maintain straightness.

Figure 3.14

Once the second course has been completed, the forms will need to be leveled to account for any uneven areas of the foundations. Although the foundation can be checked prior to installation of form units, the best method is to correct any deficiencies after the first 2 courses of Nudura form units are installed.

The forms will bridge over low areas of the foundation and ride on the high points. A laser or builder's level can be used to easily set elevations, ensuring the walls finish at the desired elevations. It is easier to fill in hollow or low areas under the form than to cut the form where foundations are high. Usually, the fix for uneven foundations will require both shimming and cutting.

Upon completion of leveling the forms, the contractor/installer can either foam the forms to the foundation or install kicker boards. Nudura recommends using spray foam as the method of securing the forms to the foundation.

3.4 ADDITIONAL COURSE PLACEMENT

As discussed before, the layout of the first 2 courses of form units are extremely critical as these set the benchmark for all additional courses above. The contractor/installer can now simply follow the pattern established within the first 2 completed courses of forms. For example, the first, third, and fifth courses, or all odd numbered courses, should be stacked identically. This includes all form cuts, rebar placement and splice laps. The same placement method is followed for the second, fourth and sixth courses, or all even numbered courses. If vertical stack joints are present within the wall length, these will need to be maintained up the entire height of the wall. The only areas that will need some modifications are around the openings and possibly service penetrations. These will be discussed in Sections 3.5 and 3.7.

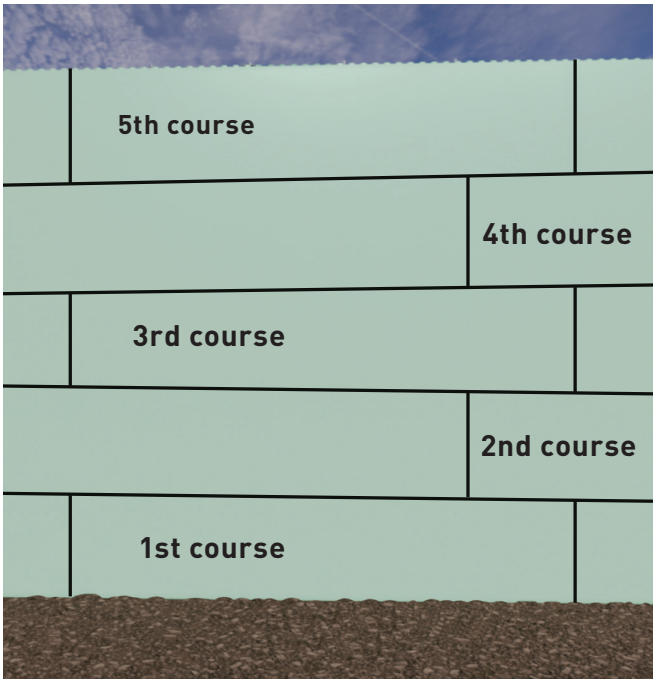


Figure 3.15

Additional form support may be required to prevent movement of the forms during concrete placement as covered in Section 3.6. The following conditions may also require additional support:

- If there is more than 102 mm extending beyond the web at a cut end
- Minimum 203 mm vertical offset is not achieved, or cut is next to a corner
- T-walls on the main wall side to resist concrete pressure
- Tapered Top form needs additional reinforcing on the top edge of the tapered side
- Window or door openings near a corner

All of these situations will need additional form support to ensure movement does not occur during concrete placement. Again, fiber tape, strapping, or strips of sheathing will work in these difficult areas.

3.5 OPENINGS

Window and door openings can be easily created within Nudura's forms using a number of different materials to frame and hold back the fluid concrete until curing has occurred. These methods can include timber material (pressure treated or wrapped plain timber), EPS end caps / EPS cavity closure for the header, steel frame, or with exposed concrete.

Figure 3.16

The structural opening (SO) dimension is the opening required to install the window or door, allowing for adjustment and additional insulation at the time of installation. It is important to establish if the type of closure being used is "stay-in-place" or to be removed prior to the installation of the window or door.

The SO in a "stay-in-place" closure will be the interior dimension. Remember to allow for the thickness of the closure material being used.

Wood closures can also be created by inserting cut or widened timber in the cavity of the form to create the required opening. It can be secured in place with expanding foam sealant and temporarily cross braced until concrete has cured.

When anchoring the timber, Nudura recommends the contractor/installer use M6-M8 screws/nails (length 100 - 130 mm). By anchoring the screw/nail into the timber and having it exposed to the cavity area of the form, once concrete is cast into the wall it acts as an anchor point. This ensures that the timber will not move once the windows/doors are installed.

When constructing the closures that will be used for the openings, the sill areas need to be left open to allow for concrete placement. Whether the closure material stays in place or is removed will be a decision for the contractor/installer, but having access to this area will allow different finishing options to be used.

Prior to the concrete placement, all required means of form support must be installed to resist fluid concrete pressures. Any corners of 1 m or less from an opening will require form support. Alternately, exterior bracing could be installed to provide support to the corner forms.

Figure 3.17

LINTEL REINFORCEMENT

Lintel reinforcement requirements will vary based on the loading conditions, depth of lintel, width of opening, concrete strength, and wall thickness. Nudura has prepared engineered Lintel Tables for Nudura walls that can be used by the engineer of recordas reference. These lintel tables are designed for a concrete strength of 20 MPa and are included within this manual.

Refer to Figure 3.19 which is a diagram of a typical opening that shows the different reinforcing pieces and where they must be placed in order to correctly install lintel steel. This diagram has been taken from the lintel tables and shows the key items that must be completed to ensure proper placement of the reinforcing steel has occurred. This also allows the contractor/installer to understand what key items need to be extracted from the tables for construction of the lintel.

Figure 3.18

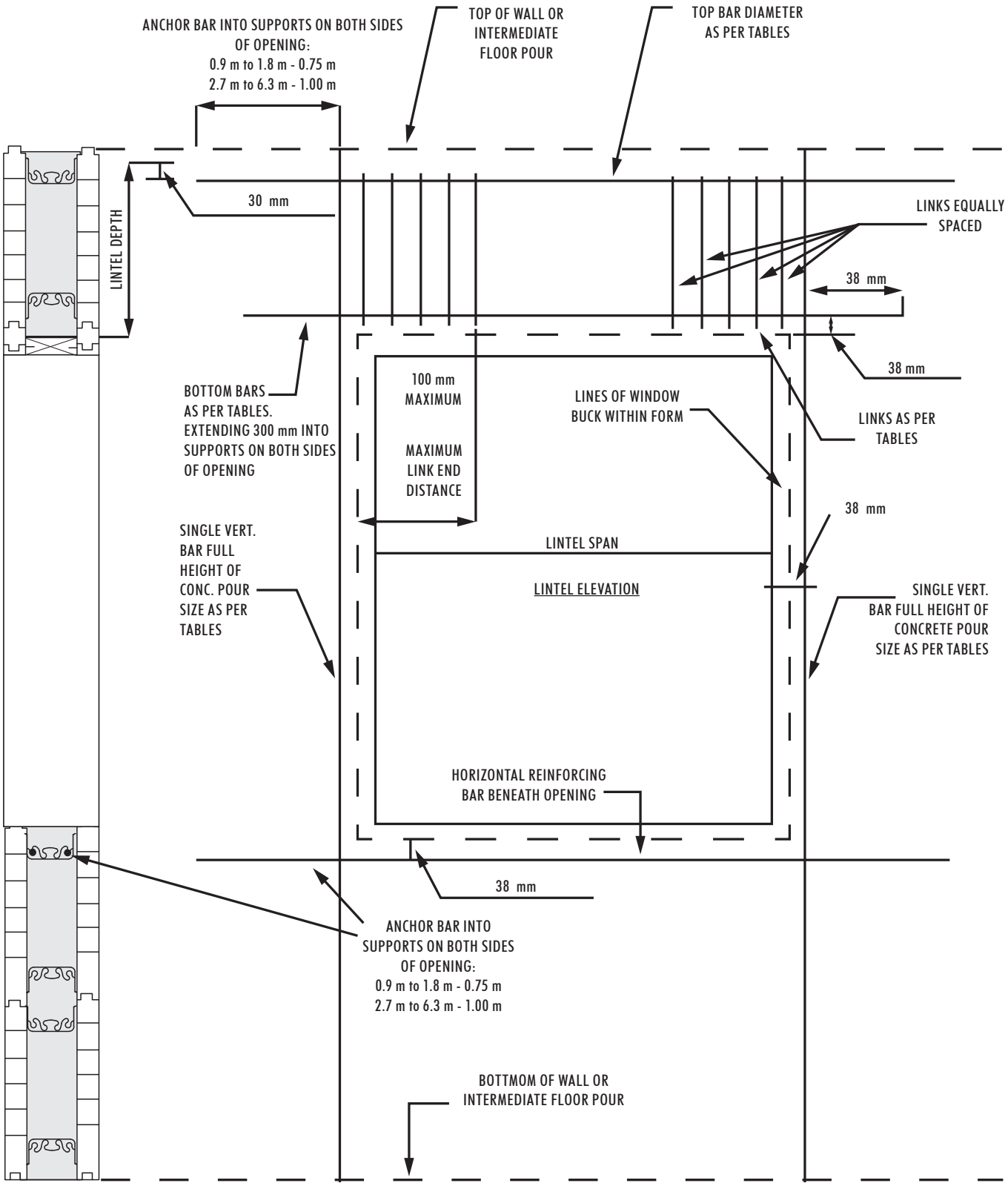

ANCHOR BAR INTO SUPPORTS ON BOTH SIDES OF OPENING:
0.9 m to 1.8 m - 0.75 m
2.7 m to 6.3 m - 1.00 m
TOP OF WALL OR INTERMEDIATE FLOOR POUR
TOP BAR DIAMETER AS PER TABLES
LINTEL DEPTH
30 mm
LINKS EQUALLY SPACED
38 mm
38 mm
BOTTOM BARS AS PER TABLES. EXTENDING 300 mm INTO SUPPORTS ON BOTH SIDES OF OPENING
100 mm MAXIMUM
MAXIMUM LINK END DISTANCE
LINES OF WINDOW BUCK WITHIN FORM
LINKS AS PER TABLES
38 mm
SINGLE VERT. BAR FULL HEIGHT OF CONC. POUR SIZE AS PER TABLES
LINTEL SPAN
LINTEL ELEVATION
SINGLE VERT. BAR FULL HEIGHT OF CONCRETE POUR SIZE AS PER TABLES
HORIZONTAL REINFORCING BAR BENEATH OPENING
38 mm
ANCHOR BAR INTO SUPPORTS ON BOTH SIDES OF OPENING:
0.9 m to 1.8 m - 0.75 m
2.7 m to 6.3 m - 1.00 m
BOTTMOM OF WALL OR INTERMEDIATE FLOOR POUR

Figure 3.19

SPECIAL CONDITIONS AT OPENINGS

This section discusses special issues that may arise with respect to wall openings including:

- Radius Topped Windows or entrance Frames
- Bow or Bay Window Conditions
- Corner Windows

Radius Topped Openings: radius topped windows or entrance frames can be easily accommodated with Nudura using one of several options for assembly. The only substantial difference from standard windows is that the lintel steel spans the full opening (regardless of the radius width), treating the very top of the radius portion of the opening as the BOTTOM of the lintel itself.

One option is to construct the opening with curved plywood inserts to suit the required framing opening. The wall area over the opening is then assembled using Nudura panels and insert webs that are cut and assembled to suit the curve of the plywood opening materials and inserts. As with traditional openings, the radius plywood inserts will require temporary support to be installed below, within the rectangular portion of the opening.

An alternate method is to build the wall as normal, using standard Nudura forms, around the square part of the opening to the start of the curved portion of the radius but at the start of the radius (as with the plywood insert option) revert to Nudura panels and insert webs, and assemble them straight across the opening. The opening below should be assembled rectangularly, ignoring the curved portion being installed above it.

Next, cut multiple foam sheets, sufficient to suit the wall cavity thickness to the exact radius profile required for the anticipated window or entrance frame. Be sure to use these as a drawing guide to trace the radius outline on the outside foam surface on both sides of the wall. Then glue the foam panels in place in the cavity over the rectangular opening.

Cut and assemble the required insert webs over the radius cut foam billet that is filling the cavity.

Install the lintel steel as specified above.

Once the concrete is cured and the opening supports are ready for removal, simply follow the guidelines to cut the foam tight to the concrete. The result will be a perfectly curved concrete radius ready to suit the window or entrance frame specified.

A third option is to build the wall as normal with Nudura panels and insert webs, again ignoring the curved portion of the opening, but constructing the wall above the standard portion as follows:

1. Trace the required radius top over the opening using the desired frame pattern on both the inside and outside of the wall forms installed above the opening.

2. Using a reciprocating saw, carefully cut the foam panels and web materials on either side of the wall, but retain these materials for immediate re-use. Be sure to examine the cut webs and insert new inserts or height adjuster ties as necessary to reinforce the panels as required where the curved line meets the opening. Repeat this for the web materials that link the panel areas that were cut.

3. Next, using metal sheet cut to the overall form depth, wrap the complete radius with the sheet material and tape it temporarily in position with fiber tape.

4. Finally, restore the cut portion of Nudura form work into the position where it was cut out and tape into position, in effect sandwiching the curved metal sheet between the insulation panels along the cut line. Provide support below and complete the concrete pour.

5. When the supports are removed, simply remove the insulation panel and metal sheet.

Bay Windows, Bow Windows and Openings Near Corners: Questions often arise as to how to handle lintel construction associated with these types of openings. The same methodology applied to straight run window lintel construction should also be applied in these situations, but bending the top and bottom steel to suit the wall's turn in axis. Be sure to adhere to the requirements for extension of both top and bottom steel, even if it means bending the steel around any corner condition occurring near the opening.

3.6 Nudura ALIGNMENT SYSTEM

A key element of Nudura's product lineup is the Nudura Wall Alignment System. This system is a multi-purpose set of components aimed at ensuring the forming system has support during concrete placement, while also providing a safe working platform for the contractor/installer. As with any scaffold system, safety must always be monitored on the project. The contractor/installer needs to be aware of, and understand, all safety codes and regulations with respect to spacing, planking, and safety rails. The alignment system has been designed to support the weight of the workers, wind loads, and the weight of the wall only. Should the alignment system be used for things other than what it has been designed for, it may result in failure and possibly bodily harm to the workers using the system.

Nudura's alignment system has been tested to meet all safety standards for most European Countries. In Europe our classification would be "Scaffold EN 12810-3N-SW06/122-H2-A-LS". Should a safety authority request documentation regarding the alignment system and its conformance to the local safety code, this is available through the local distributor for the contractor's/installer's area. Should the use of the alignment system fall outside of the general safety code conformance, site specific engineering will be required.

Figure 3.20

ALIGNMENT SYSTEM INSTALLATION

The alignment system comes in a steel crate containing 20 complete sets.

1. There are a few things that the contractor/installer should check on the alignment system to ensure it is in good working order before assembling the components onto the wall.

   (a) Check each component to ensure none of the pieces are bent, cracked, or worn out. Should the contractor/installer notice any pieces that pose any type of safety risk, the pieces need to be removed from the set and excluded from use on the wall.

   (b) Ensure the threads on the turnbuckle move freely for the full length of the threads.

   (c) Should it become difficult to turn the threads, a light grade lubricant or general purpose grease needs to be applied onto the threads.

2. The Nudura alignment system will only need to be placed on one side of the forms, preferably on the inside perimeter of the building. The alignment system will need to be laid out on the wall at 1,2 m and 1.6 m on center spacing. This will allow for proper plank spacing, as well as sufficient overlap. Remember that when laying out the spacing of the box channels the contractor/installer should also take into consideration the floor joist layout and connection method. The box channel layout may conflict with these embeds and might need to be adjusted.

3. Once the layout has been completed, the contractor/installer will need to attach the box channel (closed end (base) at their feet) to the wall. Within the Nudura form system, every 203 mm on center there are 38 mm wide fastening strips located 16 mm below the surface of the EPS foam. These are marked with a diamond shaped pattern running vertically along the form. Place the box channel up against the form, remembering to line up the outside edge of the channel with the first cut line on either side of the fastening strips. This will ensure that the box channel stays plumb the entire height of the wall.

Figure 3.21

4. Using a Nudura Hex head screw of either 5 or 6,5 cm length, placed close to the top of the slots at the back of the box channels and using a cordless screw gun, drive the screw into the fastening strip (Figure 3.23). remember to not over tighten the screw as the forms need to be able to slide vertically within the slot on the box channel to allow in the ease of straightening. One screw per course is necessary up the entire height of the wall. Also, the base of the box channel can now be mechanically fastened to the base it is resting upon.

5. Next, connect the adjustable diagonal pole brace to the box channel using the 13 mm diameter gravity pin, as shown in Figure 3.24, and anchor the diagonal foot pad base to the ground or floor with appropriate fixings.

   Contractors/installers are responsible for the holding capabilities of the drift pins/fasteners used to anchor the diagonal foot pad base. Also, remember that different lengths of drift pins will be required based upon ground type.

6. Once the diagonal foot pad base has been securely fastened, connect the catwalk bracket onto the adjustable diagonal pole brace. Take the catwalk bracket and place it, engaging the hook end of the catwalk platform overtop of the adjustable diagonal pole brace and gravity pin connection.

7. Take the second 13 mm gravity pin and install it through the box channel and bottom leg of the catwalk bracket, securing it together. (Figure 3.25)

8. Finally, the guard rail post can be attached to the catwalk bracket. Simply slide the guard rail post into the catwalk bracket stub and secure it together using the 9.5 mm x 63.5 mm lock pin (Figure 3.26). Now, add the necessary wood rails and toe kick rails as required, along with the proper scaffold planking, remembering to have the necessary overlap as needed.

Figure 3.23

Figure 3.24

Figure 3.25

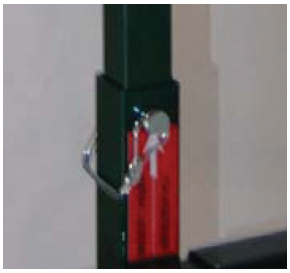


Figure 3.26

The alignment system must stay attached to the walls until sufficient concrete curing has occurred. Should the contractor/installer elect to remove the alignment system before the concrete has had sufficient curing time, temporary bracing will need to be installed. Alternatively, the contractor/installer may install the floor or roof system to provide lateral support before removing the alignment system.

IMPORTANT! In below grade applications, backfilling should not occur until sufficient concrete cure has been achieved and the sub-floor has been installed to provide lateral support against backfill pressure. Remember that concrete will achieve approximately 40% of its design strength within 3 days, 60% within 7 days, and concrete will achieve its full compressive design strength at 28 days.

Once the alignment system has been removed from the wall, remember to return the adjustable diagonal pole brace threads to the center position 152 mm of thread exposed. Also remove any concrete residue from all components of the alignment system before storage or transporting to the next project.

3.7 SERVICE PENETRATIONS

As with all installation procedures, pre-planning of the service penetrations will ensure that when the time comes to install each service, additional labor is not incurred. Most penetrations that are necessary for a building require the contractor/installer to cut out a piece of the EPS and insert the required size of material for that service to run through. It is Nudura's recommendation to contact the appropriate sub-trade for the proper size and location of the sleeve.

Below is a list of common service penetrations that may include some or all of the following items for a project;

- Water supply
- Sewer or septic pipes
- Storm sewer line
- Electrical service
- Oil filler and vent
- Natural Gas or LPG line
- Gas Fireplace exhaust vent
- Exterior electrical fixtures and receptacles
- Wood stove vents
- Hot water tank vent
- Bathroom exhaust vent
- Kitchen exhaust vent
- Dryer vent
- MHRV/MERV vents
- A/C lines
- Air Exchanger
- Audio & video service
- Spares

Installation of service penetrations is a simple procedure; the contractor/installer will need to cut a hole in the EPS as required. When laying out the locations of the sleeves, should a service penetration be located in the middle of a web, it is recommended to move the sleeve to one side or the other to eliminate the need to cut the web, which will weaken the form. Additional form support around the opening will be required, should it be necessary to cut a portion of the web in order to fit a sleeve into the desired location.

Be sure to use the correct size of sleeve to suit each service penetration individually. The contractor/installer should make sure the sleeve extends through the wall long enough to permit the use of couplers or fittings at each end. This ensures when the sub-trade has to perform their tasks, the EPS foam around the sleeve will not need to be removed to attach the couplers.

For dryer ducts or other more flexible sleeves, consider fitting the cut plugs of EPS inside the sleeve to provide additional support to the concrete during placement. These can be removed later after the concrete is cured as part of the installer's final strip and clean-up.

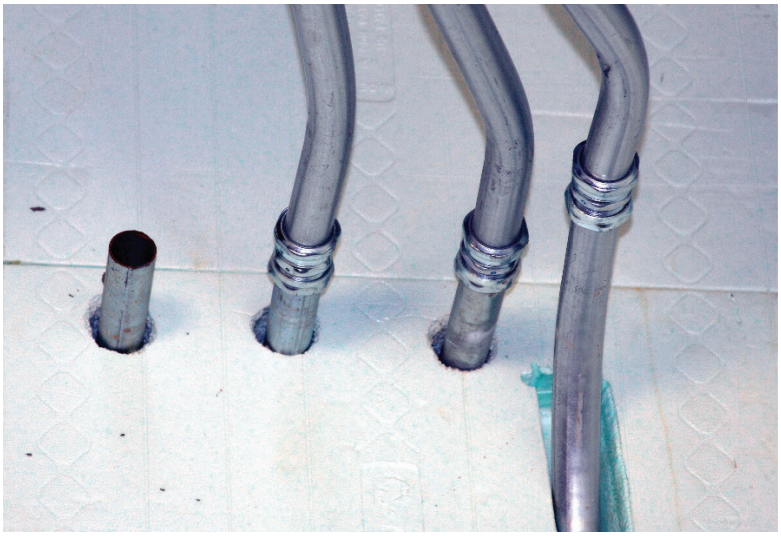


Figure 3.27

Wherever possible, coordinate with the general contractor or the various sub trades for determining any specific requirements that each trade may have (i.e. location, or, as in the case of plumbing fittings, elevation and required slope of the sleeves) prior to installation.

3.8 VERTICAL REINFORCING STEEL PLACEMENT

Once the desired height of the wall has been reached, and before concrete is placed within the wall cavity, a final row of form lock, as well as the vertical reinforcing steel, should be placed into the wall.

The form lock should be installed first as it needs to be force fitted in between the EPS panels as previously discussed. Once the form lock has been completed, the contractor/installer can now install the specified vertical reinforcing steel.

Once the vertical steel has been determined, simply start at the corner that has been designated as the starting point for concrete placement and weave the vertical steel between the horizontal steel. This will lock the vertical steel into place and prevent it from moving side to side within the wall cavity. Continue to slide the steel into the cavity at the specified center spacing around the perimeter of the project.

In most of Nudura's forms, if the vertical steel specified is below 16 mm in diameter, the horizontal dowels may not fully capture the steel solidly enough to prevent it from moving in the longitudinal direction of the wall axis. In this case, by offsetting the form look it can be used to hold the vertical steel in place.

The top of the vertical reinforcing steel will terminate, as specified below, at the top of the forms. Should additional storeys of Nudura be needed, wet setting the dowels are recommended over having the vertical steel extend above the last form. An alternative method to wet setting dowels is to install another course of the forms using these forms as a funnel for concrete placement. Remember to terminate the concrete below the top of the forms of the specified lap splice distance as required for the reinforcing steel being used.

After all the form units are installed, and prior to the placement of concrete, the vertical reinforcing steel should be terminated as specified below the top of the wall. If successive storeys are to follow, construction joint reinforcement dowels should be installed as per the vertical reinforcing steel placement.

Field experience has proven it is easier to insert joint reinforcement dowels after the concrete placement versus working with longer, vertical reinforcing steel which can interfere with the concrete placement within the forms.

Figure 3.26

3.9 SPECIAL APPLICATIONS

FLOOR CONNECTIONS

Before concrete is placed into the forms, some additional steps need to be considered, dependant upon what stage of construction the project is currently under. If the current stage is the foundation with additional stories to follow, the attachment of a floor will have to now be considered. This is essential because in some residential structures these floors are using wood joists with plywood sheathing. Should the floor connection be something other than light framed wood floors, an engineer's design will be necessary for the reinforcing required in the walls. This method of floor connection does need to be pre-planned before concrete is poured into the forms. First the contractor/installer needs to decide what method will be used for hanging a wood floor from the concrete wall. There are several methods for connection of the floor joists to the concrete wall that include the following;

- ICF Hanger System
- Simpson Strong-Tie (ICFVL™)
- Simple Anchor bolt
- Modified Anchor Bolt with Moment Connection Plate
- Ledge Support.

Figure 3.29

ICF Hanger System: The ICF Hanger System is probably one of the fastest and easiest methods for wood floor attachment with the least amount of additional labour.

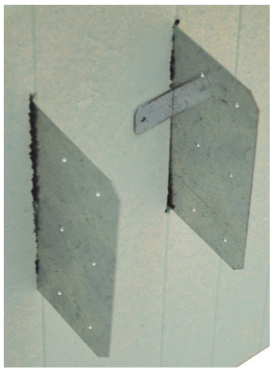


Figure 3.30

Simpson Strong Tie ICFVL™: Like the ICF Hanger System, the Simpson Strong Tie ICFVL™ System connection requires the embedment of a galvanized plate through the foam into the concrete. This will additionally require a ledger board to be attached to the embedment, along with shear connection J Brackets at each embedment, and joist hangers for the floor members to rest into. For the full installation, and recommended spacing, please refer to Simpson Strong-Ties web site.

Simple Anchor Bolt: Although more labour intensive than any other method, one connection method is the use of horizontal embedded anchor bolts. Again, a ledger board and joist hangers are required. This method will require the removal of some EPS foam to allow the concrete to flow out flush with the face of the form. Once the concrete has been placed and partially cured, simply remove the temporary form, drill and attach the ledger board, and connect the joist hangers as required for the floor joist spacing. One thing to note is how the EPS has been cut in the form. These cuts ensure that during concrete placement voids will not occur in this area. Proper consolidation of the concrete will also ensure the pocket becomes encased with concrete. Please refer to proper concrete consolidation techniques in section 3.10.

Modified Anchor Bolt with Moment Connection Plate: Some manufacturers also distribute modified anchor bolts which contain a welded square plate in line with the l shaped bend of the anchor bolt. The plate is designed to the same thickness of the Nudura EPS panel. These special bolts are engineered to handle the bending moment condition that is typically created because of the extension of bolt beyond the concrete surface. The plate enables transfer of the vertical loads laterally into the face of the concrete. As with simple anchor bolts, this system Also requires floor support ledgers and joist hangers. However, the big plus with this system is that the bolts can be pre-installed into the foam with very simple horizontal slit cuts as opposed to having to remove full foam segments making them much less labor intensive to install. Be sure to check with the manufacturer for any supporting engineering documentation for this option.

Ledge Support: A ledge can also be created by using forms of different widths as shown in Figure 3.31. By using Nudura taper top forms as the ledge for the floor joist to rest on, and connecting a smaller width form to the tapered top (using the Nudura Form transition bracket Accessory), a ledge is created. The smaller width form must be able to create a ledge that, by code, will allow enough end bearing to support the joist.

Figure 3.31

BEAM POCKETS

Beam pockets are another very important structural element that need to be planned for before any concrete is placed within the forms. Beam pockets can be placed anywhere along the length of a Nudura wall. Again, the floor plans will provide the contractor/installer with the exact location of the beam placement to carry the required members to the solid wall. Additional vertical reinforcing steel may be required at these locations to ensure the loads are transferred correctly throughout the wall section. If the contractor/installer is referring to alternate design information, check within the appropriate areas pertaining to beam pocket reinforcing. The contractor will need to check all measurements to ensure the pocket is in the correct location to receive the beam at a later part of the construction process.

Figure 3.32

One method for creating a pocket is to use 2 of Nudura's end caps and slide them into the cavity of the wall for the location of the beam (smooth sides facing the concrete). The contractor/installer needs to make sure there is access to screed the bottom of the pocket flat to help reduce the number of shims required for the beam to rest on. The detail on the right demonstrates how the end caps are slid into place along with cutting open an area to allow the contractor/installer an opportunity to screed the bottom of the pocket smooth. Once the concrete has been cast into place and cured, the contractor/installer will simply cut out the EPS and remove it from the pocket area. The beam is then installed similar to typical construction practices. Alternatively, the beam can be placed in the wall and supported, prior to concrete placement.

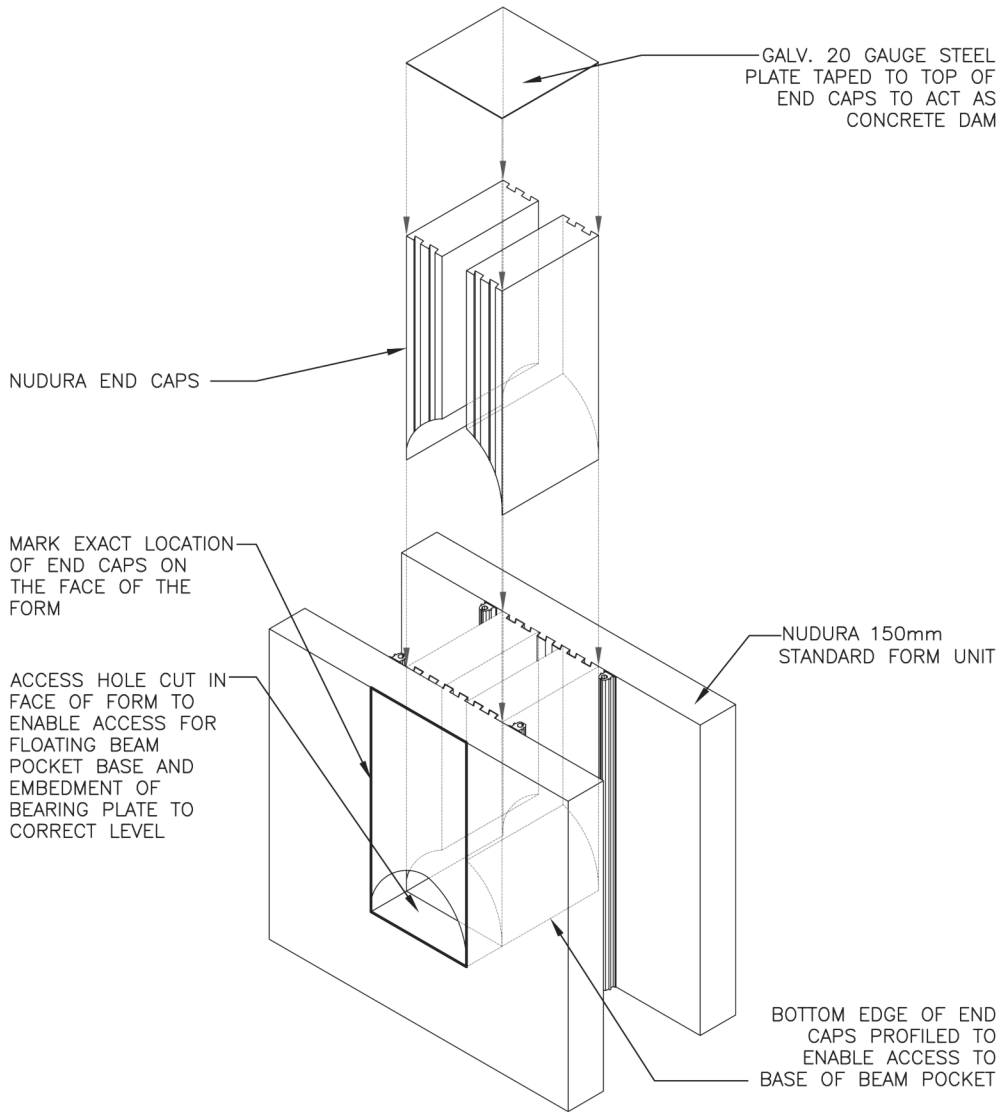


Figure 3.33

Another method is to take a piece of EPS foam and cut it to the desired dimensions, then spray foam this to the inside of the panel on the side of the wall that the beam will rest onto. As stated above, access to the bottom of the pocket will allow the contractor/installer the opportunity to screed this area smooth for the beam to rest on later. (Bearing or weld plates can also be taped in place to the bottom of the foam if desired, though care must be taken to adequately vibrate the concrete below the embed plate, using this method). As with the first option, after the concrete has been placed and cured, the contractor/installer simply cuts and removes the EPS foam from the pocket area, and the beam is then installed as per normal procedures.

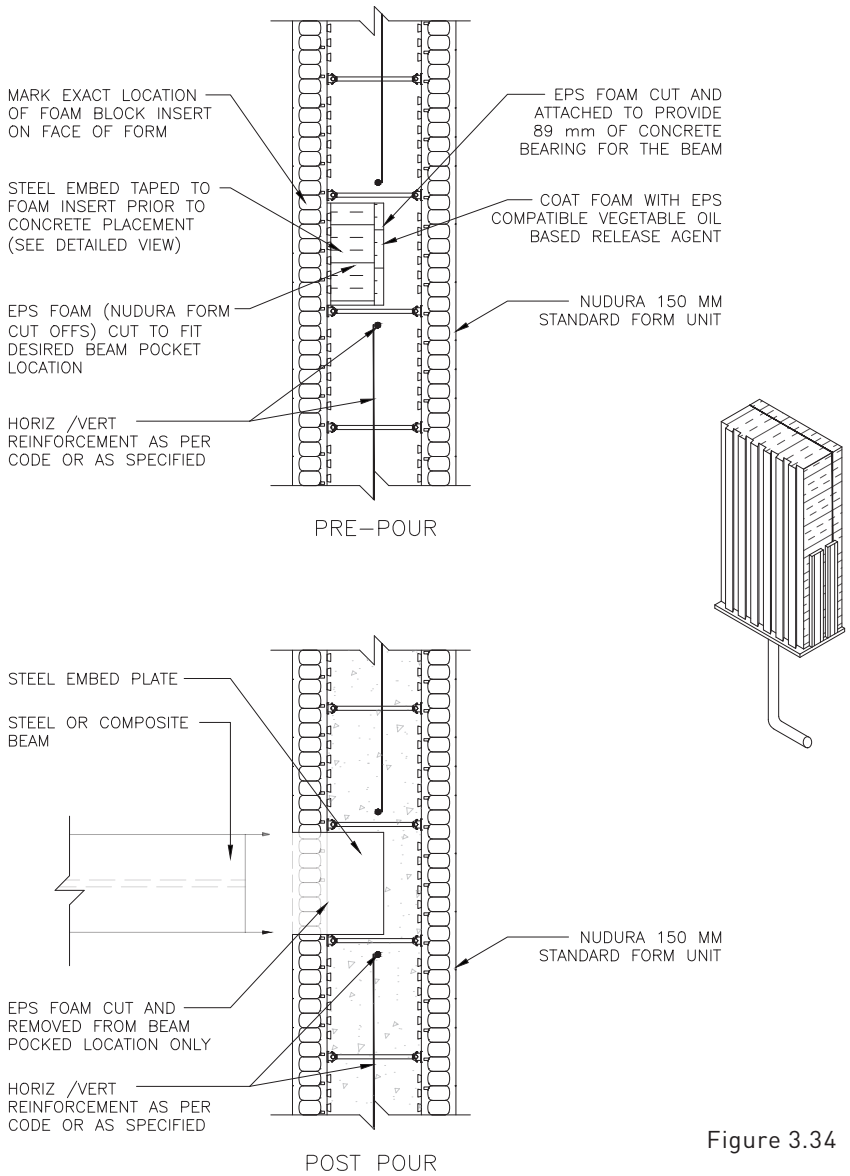


Figure 3.34

BRICK CORBELS

Nudura's brick corbel form units have several uses, including supporting masonry loads and supporting floor joists. However, the brick corbel is not available in a corner form option (in any angle) and therefore the creation of an in-field corner brick corbel will need to be made. Installation of the standard brick corbel follows the same requirements as a standard straight form. Once the contractor/installer comes to a corner condition a decision needs to be made regarding the creation of a corner brick corbel.

Option 1- Full Form Miter Cut: One method for construction of corners is to take 2 forms and miter cut them following the profile of the corbel on the outside panel, and creating a square cut on the inside panel to complete a corner form condition. Remember that all cuts need to be performed away from the wall area to prevent a build up of EPS shavings (or foam fray) in the bottom of the wall. Once the miters have been completed, take both pieces of form and lock them onto the wall. Nudura's 25 mm fiber tape will now be required to tape the corbelled corner and provide strength during concrete placement. Should the miter cuts on the corbel not be exactly tight together, the contractor/installer can fill any gaps using the illbruck foam. This will accomplish two things; it will add additional bonding of the two forms at the miter location and it will also fill the gaps, not allowing concrete to leak from this area.

Option 2- Corner Forms with Brick Corbel Extensions: The 2nd method that can be used is to construct the corner using the standard 90º or 45º corner form as the basic structural integrity of the corner condition, but then, fitting the form with Nudura's brick corbel extension Form Accessories to complete the corbel condition. This method has the added benefit that it maintains the structural integrity of the standard corner form throughout the condition and can, in most cases, be a more cost effective option for constructing the corners. To see detailed explanation on the correct method of construction to be used, refer to the technical bulletin found under Appendix F in this manual.

In either case, once the brick corbel condition has been constructed, the reinforcing steel can now be added to help support the brick that will be installed later in the construction process. The steel needed to accomplish the reinforcing consists of 3 different pieces. The first is the horizontal steel location in the main cavity of the wall. Its location is critical as it helps to support the brick corbel hooks. Nudura recommends that the horizontal steel be placed within the second notch of the web from the inside face of the form.

Also, this reinforcing steel will be required to have a contact lap splice in order for the hooks to be located correctly (see Figure 3.35). At the outer edge of the brick corbel (and the brick corbel extensions), the contractor/installer will also need to place a horizontal piece of reinforcing steel to allow the brick corbel hook to rest on. This piece of steel will not require a lap splice as it simply acts as a holder for the hooks. The brick corbel hooks can be created either in the field, or be provided pre-bent to the site by the reinforcing supplier. Nudura can provide details showing the bend locations along with the required dimensions for the various wall thicknesses. Contact the local distributor for copies of these brick corbel hook details.

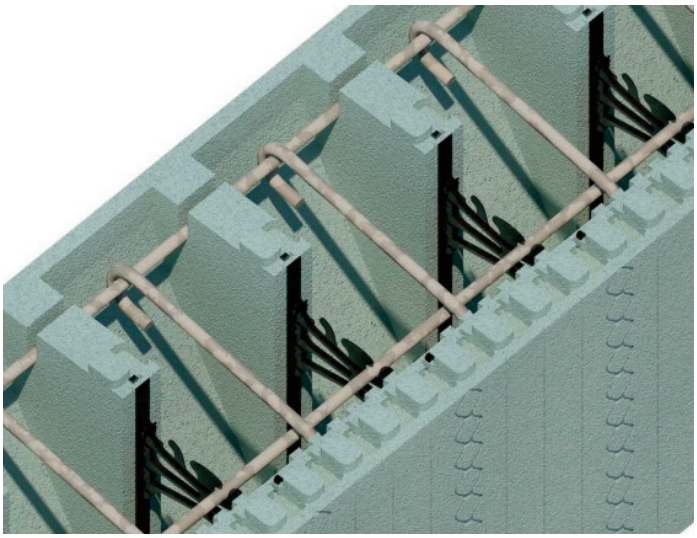


Figure 3.35

GABLE ENDS

If the structure is using parts or all of the roof section as habitable living area, and these areas include gable ends, it is beneficial and effective to use the Nudura wall system for these parts. One of the simplest methods for creating a gable wall is to use Nudura's standard form units to build the gables by simply cutting the forms to the desired slope of the gable. Remember that the cut off portion of the panel is not waste and can be re-cut to form the opposing slope of the gable end. This results in little or no waste, depending upon the pitch of the roof. The cut edges of the gable will require additional support during concrete placement to prevent flaring out of the panels due to the cutting of the webs. Simply taking timber battens or similar material and screwing into the fastening strips of the panels will ensure the gable ends maintain straightness during the concrete placement. The Nudura alignment system then can be installed to support these areas.

Figure 3.36

Should the gable wall have a window opening located within it, treat it like any other opening.

When placing concrete into the gable ends, it will be necessary to reduce the overall slump from the typical 150 mm to about 100 mm slump. Also, depending upon the gable end slope, it might be necessary to reduce the pour lift heights from 1,20 m) to 0,6 m. Consolidation of each lift is critical to ensure voids do not occur within these areas. Regardless of slope of the gable, with the reduced slump there is no fear of the concrete slipping out of position as the regularly spaced web network inside the forms serves to prevent this from happening.

Once the gables are completely filled with concrete, remember to screed the top of the walls flat and adjust the walls to obtain straightness.

PILASTERS

Pilasters can be created, using different methods from products already discussed in this manual. Here are some of the available options:

1. Pilasters constructed using standart form units and end caps
2. Pilasters constructed using the 4 Way Web Connector and Nudura panels
3. Pilasters constructed from conventional form systems and attached to the Nudura form units

All of these methods will require additional form support, as portions of the wall will be compromised due to cutting of the webs.

Standard Form Unit Method: if the building requires a pilaster of 305 mm or less, construction of the pilasters using Standard Form units and the T-Form Support Strap is a quick and easy option that will allow the contractor/installer the opportunity to build them fully using the Nudura technology. The Standard Forms will allow the contractor/installer to build the pilaster as necessary to meet the specifications required. This helps in the placement of the steel reinforcement necessary for the pilaster to be placed where needed.

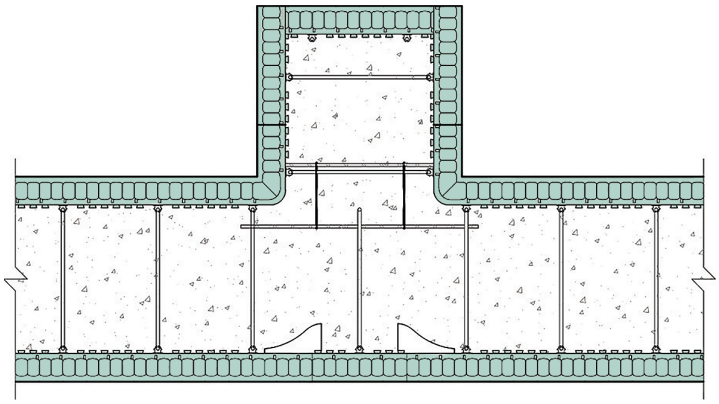


Figure 3.37

Panel and 4 Way Web Connector Method: Pilasters can also be created from Nudura's panels, insert webs, and 4 way web connectors. These can be created by simply cutting the panels to match the required dimensions of the pilaster specified. A combination of insert webs to create the pilaster width and depth will require the use of Nudura's 4 way web connector. Additional support will be required in the corners to prevent concrete from creating a problem during placement. illbruck´s spray foam will connect the panels together, giving the necessary bond strength to resist concrete.

Conventional Forming: The final option is to build the walls using the standard forms, cutting away the foam, and create a pilaster using regular forming. This sometimes maybe preferred due to the amount of reinforcing steel needed for the pilaster to support the loads imposed upon it. Should this be the method, simply cut out the required amount of foam from the main wall. Do not forget to add additional support to the opposite side of the Nudura form to resist concrete pressure. Complete the pilaster as per normal techniques. Use the T-Form Support Straps with the conventional forming to ensure the pilaster does not move under concrete pressure.

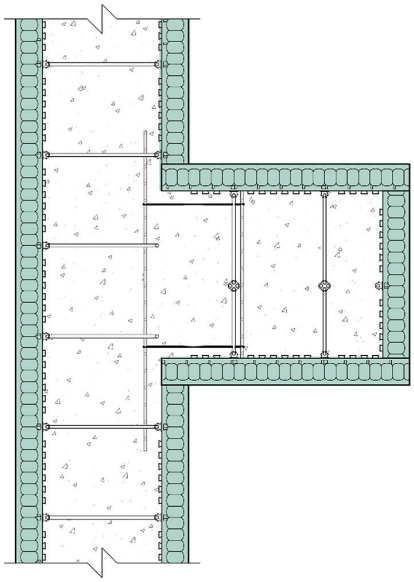


Figure 3.38

ROOF CONNECTIONS

Before concrete is placed into the forms some additional steps need to be considered for connecting a roof to the concrete after it has cured. A couple of different methods can be used to connect a roof to the concrete walls.

- ICF Hanger System
- Anchor/Wedge Bolt
- Tie Down Straps

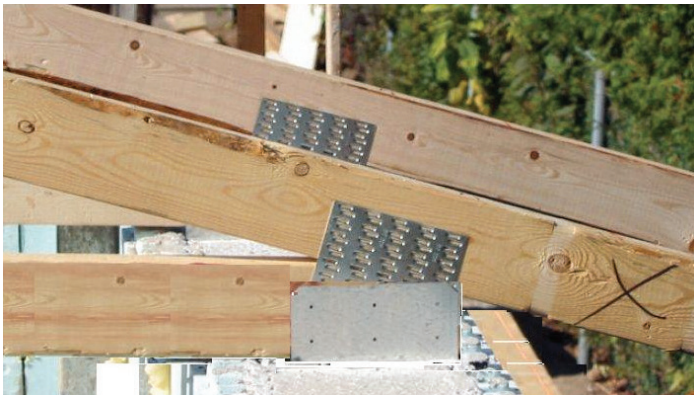


Figure 3.39

ICF Hanger System: The ICF Hanger System can be used as a connection to accept the roof member and allowing a solid connection to the concrete wall. One thing to remember is you will have to ensure you have your layout for the roof members before installing the ICF Hanger System.

Anchor/Wedge Bolt: Anchor bolts can be set into the wet concrete at the required spacing as per specification. Typically, anchor bolts must be minimum 12 mm diameter but may be required to be 16 mm diameter where prevailing wind loads dictate depending on the local specification. The bolts are typically required to be embedded not less than 100 mm when final set into the top of the concrete in the formwork. Though bolts are typically spaced not more than 1.2 m apart, again depending upon specification, seismic region and wind speed, bolt placement may be required to be as close as 400 mm o/c.

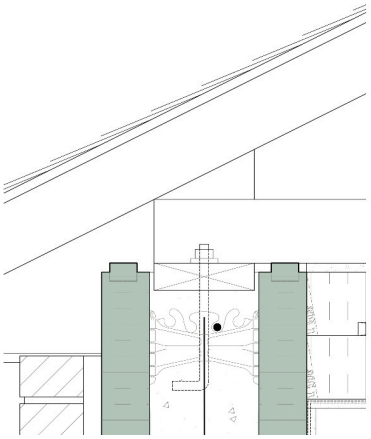


Figure 3.40

Specific roof anchor plate designs may vary from building to building, but when using a dimensional wood roof anchor plate with cast in place anchor bolts, the commonly preferred method is to have the roof anchor plate nested (fully protected) between the inner and outer insulation panels of the form with the top of the plate just clearing the top of the form insulation panels.

To achieve this feature during final concrete placement, the installer may wish to consider creation of a simple wood hand trowel/concrete screed consisting of a plywood sheet cut to appropriate size, a simple handle mounted on top, and the bottom of the plywood plate being fitted with an 200 mm long scrap of wood measuring 45 mm thick by the desired form core width 101, 152, 203, 254, 305 mm. This tool can be used once the finished wall pour height is achieved, to screed the concrete level to the desired 38 mm depth below the top of the form insulation. Using this in conjunction with a laser level can enable even greater accuracy for final plate placement.

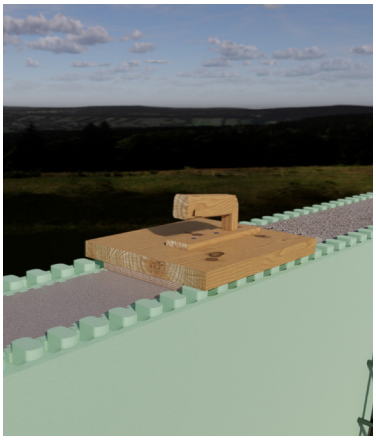


Figure 3.41

Wet set bolt placement at the specified locations and depth can be made once the concrete has been leveled as noted before. The concrete must be sufficiently set to ensure the bolts will remain vertical.

Once the concrete has cured, a damp proof membrane (DPM) or illbruck liquid membrane is then installed. After initial placement of the DPM or liquid membrane over the bolts and wall, transfer the bolt locations to the bottom of the plate and then pre-drill the plate with clearance sized holes to enable the plate to drop over the bolts. Once the anchor plate is finally anchored into position with finish washers and nuts, the typical layout for the roof system can be completed.

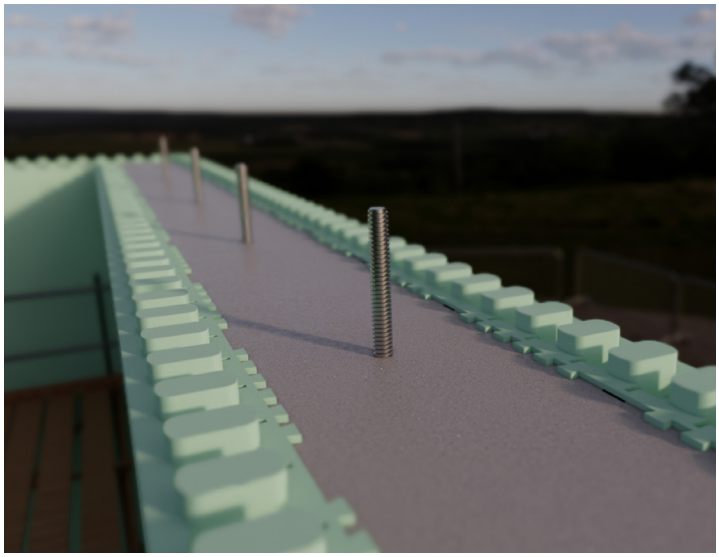


Figure 3.42

NOTE: For roof truss and rafter anchorage to the roof anchor plate, be sure to reference specifications for your regions. Some regions may require the additional provision of "tension ties" to provide additional fastening of ceiling joists or bottom chords of the trusses to the top of the roof anchor plate at 1200 mm centers or even less spacing depending upon prevailing wind speed. These may be specified even over and above any required anchorage against hurricane force winds.

Tie Down Strap: The ICF Hanger System or a similar embedded strap system can be used for areas that require a roof connection to meet a specific wind speed or pressure typical for coastal areas. The manufacturers' installation instructions need to be followed along with having the roof layout before any placement of concrete is placed into the forms.

NOTE: if a pre-engineered roof truss has been specified as the required roof system; ensure the bearing point for the truss is located over the concrete as the EPS will not be able to support the loading conditions of the roof.

3.10 CONCRETE SPECIFICATIONS AND PLACEMENT

The concrete mix design shall meet the engineer's specifications and conform to national and local standards, regulations or codes having jurisdiction. The main characteristics and specifications for a Nudura compatible concrete mix should be as follows:

- Cement: Categories CEM I, II, III, IV, V
- Designed compressive strength at 28 days: 16 MPa for plain wall design and minimum 20 MPa for reinforced wall design
- Slump on site: S3 (125 to 150 mm)
- Water/cement ratio: Maximum 0.5 to 0.6
- Aggregate maximum size:
    - Wall Cavity of 100 mm and 150 mm nominal concrete thickness: 10 mm to 15 mm aggregate size
    - Wall cavity of 200 mm, 250 mm and 300 mm nominal concrete thickness: 20 mm aggregate size
- Maximum binder content: 360 kg/m^3
- No air entrainment (usually 3% to 5% present naturally)
- Fresh concrete density: 2400 kg/m^3 ±
- Setting time (dependent on temperatures): 3 – 7 hours
- Concrete design strength should be reached at 28 days

Check this specification with your local concrete supplier. Most concrete companies now feature design mixes formulated with mid-range water reducers that are specifically designed to work in insulated concrete Forms systems. These mixes give better flow-ability of the concrete with reduced water content and more cohesiveness that assures no segregation of aggregate during placement. The use of plasticizers and admixtures can increase the amount of pressure the liquid concrete exerts on the form units. Increased liquid pressure can result in failures and therefore admixtures should be used cautiously at the contractors own risk.

The Nudura form units made of EPS (expanded polystyrene) will enhance the curing of the concrete as follows by:

- Providing consistent curing environment for the concrete
- Giving excellent thermal protection in the cold weather and extreme heat
- Minimizing surface shrinkage which is the cause of cracking in concrete walls
- Controlling moisture loss inside the concrete while curing, which is the major cause of cracking
- Preventing moisture loss due to air/wind exposure

Typically, concrete design strength characteristics and number of days at which the design strength will be achieved are as follows:

- 3 days - the concrete achieves approximately 40% of its design strength
- 7 days - the concrete achieves approximately 60% of its design strength
- 28 days - concrete compressive design strength should be reached

The placement of concrete in the Nudura forms shall be in accordance with the plans and specifications, and must comply with local standards, regulations or codes having jurisdiction. Various methods of placement can be used depending on the accessibility to the site and the characteristics of the project. Other variables such as temperature, mix design, and reinforcing pattern in the wall may influence the builder's decisions as to the technique selected for the concrete placement. Concrete can be placed using the following methods:

- Concrete boom pump
- Concrete pump
- Crane and bucket
- Conveyor belt on or off the truck
- Directly off the truck by chute

The concrete boom pump is the preferred method for above grade construction when available. When using a boom pump it is important to have a reducer to reduce the pipe down to a suitable diameter.

The contractor and crew should familiarize themselves with the proper technique and use of the vibration equipment supplied for the job before concrete placement begins. A recommended practice for a standard whip vibrator is to insert the vibrator full depth of the concrete lift at between 400 and 600 mm intervals and withdrawing the vibrator slowly at a rate of about 300 mm per second after each insertion.

Figure 3.43

Though following the practices recommended in this installation manual will assure maximum efficiency and safety during the pour, it's a good idea to ensure that preparations are made for handling a form blow-out, should anyone miss cross checking for adequate from support etc. The contractor should ensure that prior to concrete placement, one or more kits are prepared to have at the ready should such an occurrence arise. A blow out kit can consist of such simple materials as a 600 mm x 600 mm square of 13 mm plywood Nudura screws and a screw gun. Having these ready will save valuable time should a blow-out occur.

PRE-PLACEMENT CONCRETE CHECKLIST

- ❑ Is wall built according to drawing?
- ❑ Has all additional support been installed?
- ❑ Is rebar installed per plans or as specified in the correct location?
- ❑ Is lintel rebar installed correctly?
- ❑ Is Nudura alignment system installed correctly?
- ❑ Have all openings been installed and in correct location?
- ❑ Do you have correct size of structural openings?
- ❑ Has proper anchorage for timber material been used?
- ❑ Construction joint reinforcement or protection for protruding rebar?
- ❑ Have all service penetration sleeves been installed?
- ❑ Have all T connections been braced?
- ❑ Have all beam pocket preps. Been installed and in correct location?
- ❑ Have all string lines been installed around perimeter of building?
- ❑ Have walls been straightened?
- ❑ Has all interlock been protected?
- ❑ Is there adequate support on gable ended walls?
- ❑ If in winter construction, has form cavity been protected against snow or ice build-up on the night previous to the pour?
- ❑ If no protection had been provided, have measures been taken to remove all snow and ice from the forms?
- ❑ Are roof or floor connection anchors on site?
- ❑ Do you have a tool for consolidation? (Concrete vibrator)
- ❑ Are there back up materials in case of blowout? (i.e. blow-out kits and screw gun available)
- ❑ Is the concrete order as per code, or as specified?
- ❑ Has the quantity of concrete been properly calculated and checked against the build?
- ❑ Has the timing of trucks been properly coordinated with the plan for the pour and relayed to the concrete company?
- ❑ Is there enough room for concrete pump or trucks to maneuver on site?
- ❑ Has operator been made aware of all trees, roof overhangs and power wires?
- ❑ If pouring with a pump are there reducers?
- ❑ If pouring by other means is there enough room to maneuver around site?

TOOLS FOR CONCRETE PLACEMENT

- ❑ Trowels
- ❑ Homemade trowel to recess plate
- ❑ Concrete vibrator
- ❑ Laser level
- ❑ Hand level
- ❑ Ladders
- ❑ Wheelbarrows
- ❑ Normal hand tools
- ❑ Cordless drill and screws
- ❑ 1,2 m to 2,4 m straight edge
- ❑ Material for supplementary bracing and straightening
- ❑ Hand shovel

The operations outlined here are for a four man work crew and a typical pour. Please note that operations can vary widely from what is depicted here depending upon job complexity and size.

Slump of the concrete should be checked by the crew lead before placement begins to assure it is being pumped at the specified mix. Accurate records of the concrete delivery tickets should also be kept during concrete placement for later reference in the event that concrete testing is required.

Ideally, the lead hand should be working the hose alongside the pump operator on the catwalk platform. A labourer should follow immediately behind the lead hand with the vibrator, consolidating as the lift is placed. Communication between pump operator and the crew lead operator at the hose end is crucial. If the pump operator does not have remote equipment, radio, or clear hand communications between these operators will be essential for a successful pour.

Additional labourers should be on the ground assisting in mechanical internal vibration especially at window openings, and watching carefully for wall movement or potential situations that may arise due to concrete pressures filling various areas of the formwork. These crew labourers should also be ready with embeds or accessories and tools as needs may arise during the pour. The crew on the ground should always be cautious of the boom position and be ready to react in the event of any emergency that should arise with the pump equipment.

Concrete placement rate should not exceed 1,2 m of lift per hour. When placing concrete the contractor should avoid stopping a pour against an opening or in a corner. A pour should always be terminated at the center of the longest wall when possible.

Consolidated concrete will be dense, homogenous, and free of cold joints, voids, and honeycombing. The concrete shall be well bonded to all reinforcing steel, anchors, and embedded parts, such as bearing plates. Internal mechanical concrete vibration is the most effective method to use to assure the highest level of monolithic consolidation. Consolidation of the concrete should always start at the base of the wall and continue upward as each concrete lift is placed. The completed lift should be consolidated before the next lift is deposited.

When consolidating subsequent lifts, the consolidating tool must completely penetrate the lift and extend into the upper portion of the previously placed lift, to ensure proper mixing of the concrete at the interface between lifts. Depending on core thickness a 20 mm to 50 mm) concrete vibrator is the maximum size recommended for consolidating concrete in a Nudura wall. Be sure that the shaft length of the vibrator is long enough to reach the bottom of the wall height being constructed.

As the concrete placement operations near the top of the wall pour, one of the ground labourers should move to the scaffold platform to assist with embed placements, beam pocket screeding and wall leveling. A labourer should remain on the ground to assist the crew lead with the alignment system checks. An initial alignment should be made to plumb and to assure visual straightness. Once the crew has completed leveling, screeding, and anchor bolt and embed placement, the crew lead should complete fine adjustment with a single laboUrer on the ground to ensure that minimum movement of the alignment system is made during the final plumb and straightness checks of the wall installation.

Once the work is complete, the crew finishes off with final clean-up of the site and the equipment and completing the post-placement checklist.

POST PLACEMENT CONCRETE CHECKLIST

- ❑ Have the walls been preliminarily straightened to plumb?
- ❑ Are openings plumb?
- ❑ Have all walls been properly consolidated?
- ❑ Has the top of wall been screed level?
- ❑ Have all beam pockets been screed to level where accessible?
- ❑ Have all anchor bolts and embedment has been installed and concrete consolidated at these inserts?
- ❑ If continuing up wall, is all cold joint reinforcement in place with proper lap splice and top of concrete left rough?
- ❑ Once all cross checks completed above, has final fine adjustment of all walls been completed using installed string lines, tape measure and laser level?
- ❑ Have all tools been cleaned and put away?
- ❑ Cold weather pouring – has top of wall been protected from freezing?
- ❑ Has alignment system been cleaned of all excess concrete?

4.0 Waterproofing & Sealing

4.1 BELOW GRADE WATERPROOFING

Building codes require waterproofing when the interior floor level is below the exterior grade level. Tremco CPG Europe provides different fit-for-purpose solutions. **Nudura Waterproofing Membrane** is a self adhesive peel and stick membrane designed for below grade waterproofing applications. It is composed of styrene-butadiene-styrene (SBS) modified bitumen and a polyethylene woven complex. This surface provides 100% protection from UV radiation. A silicone release paper protects the adhesive side of the membrane. The Peel+Stick membrane is used with the Nudura polymer-emulsion-based primer. Another solution could be the use of a liquid applied coating. E.g. **illbruck OS925** is a thixotropic bitumen-latex emulsion which forms an elastic air- and waterproof and seamless barrier seal.

All compatible waterproofing membranes must be installed as per manufacturer instructions.

For detailed instructions on how to apply Nudura Peel+Stick or illbruck Liquid Membranes please refer to installation instructions.

Figure 4.01

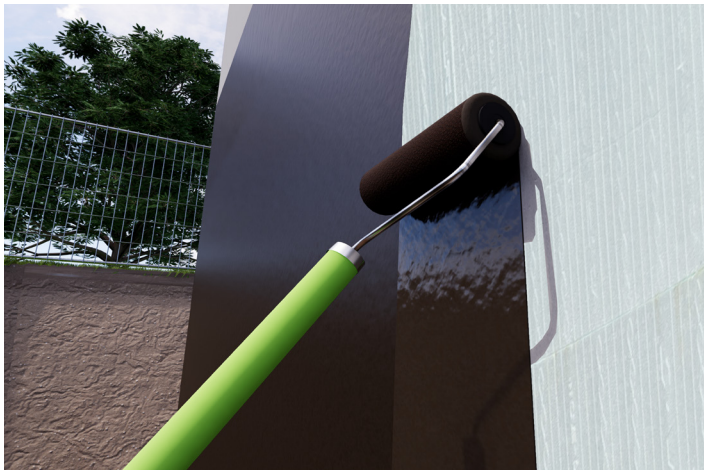


Figure 4.02

Figure 4.02a

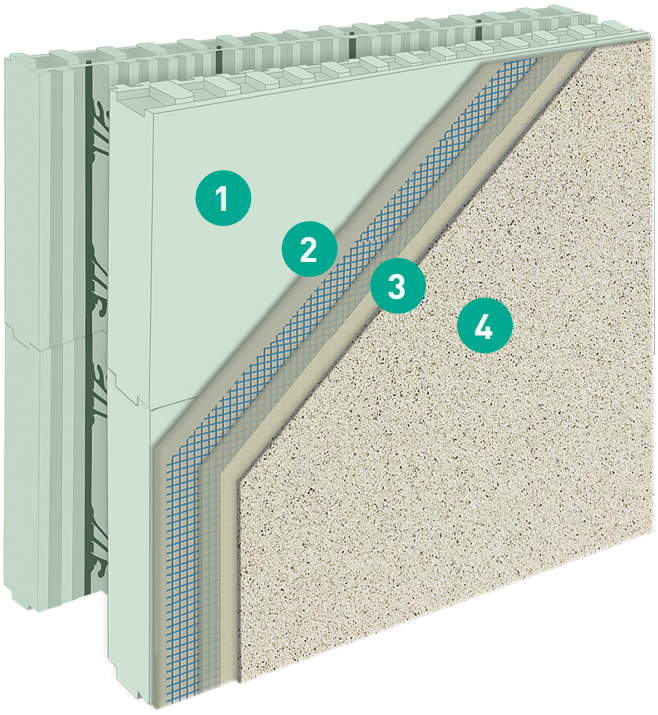
4.2 RENDER COATING

As with all Nudura products and accessories, the **Dryvit ICF 500** render coating system is another of the important elements of construction that's unique to the installation procedure. 'Render coating' is a term to define the thin coat of cementitious or polymeric mortar that is applied for refinement of its surface.

As is common in conventional construction methods, the purpose of render is to provide smooth finish of the band of foundation wall surface that is typically exposed between the final grade of a building and its intended above grade finish material. This is especially true in more northerly climates where, because of snow and frost penetration in ground, building codes may require a definite separation of the ground from the above grade installed finish, usually a minimum of 150 mm.

When applied to the EPS foam, the render is typically applied to lap overtop of the Waterproofing membrane by 65 mm and then extends to either the underside of the wall veneer finish. As outlined in this section, the render is typically applied in 2 coatings with a fiberglass mesh interlay that is applied and floated into the first coat.

Please refer to Dryvit certifcation documents, technical data sheets and installation instructions.



1. Nudura formwork
2. Dryvit basecoat with reinforcing mesh
3. Dryvit Primer
4. Dryvit finish

4.3 WINDOW AND DOOR INSTALLATION

This section of the manual is intended to give the contractor/installer guidance for installation of the doors and windows into the structual openings that were created prior to concrete placement. As with all installations, Nudura recommends that the contractor/installer follow all of the window and door manufacturer's installation methods. Window and door locations within the opening will be determined from the details within the plans and specifications.

This section is intended to help guide a window installer in preparing an opening to receive a window or door.

Before windows and doors can be installed, the owner/installer will need to know the designer's preferred placement position of the window or door frame within the depth of the Nudura wall. This is necessary as it will vary how the installer will prepare the opening for receiving the window or door.

The preparation of the openings will vary. Consult your local Tremco CPG representative for technical information.

5.0 MEP and Interior Finishes

5.1 ELECTRICAL

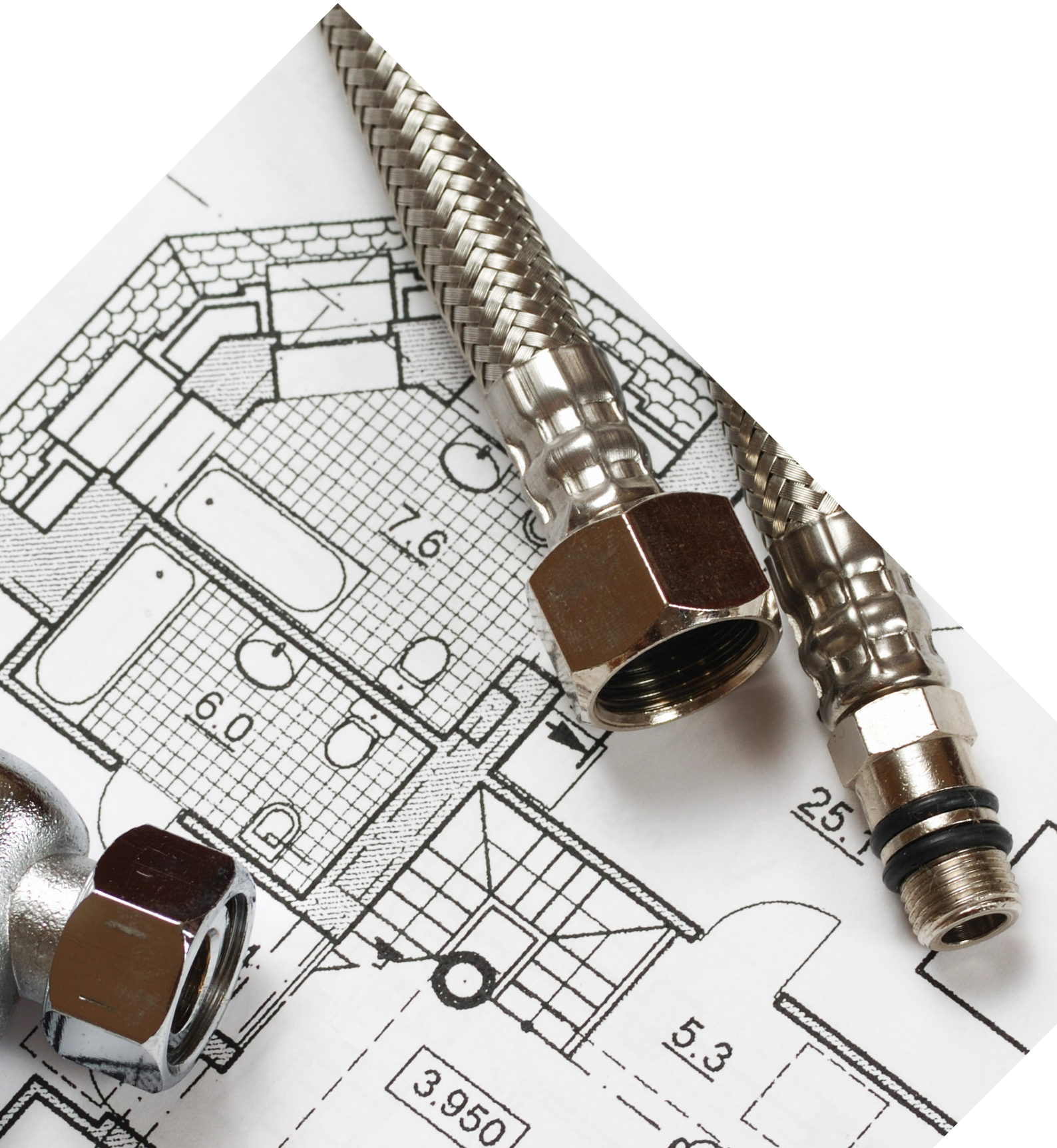
As with all aspects of construction, the electrical within a building is also dependent upon local code.

There are some differences from conventional building material, compared to Nudura, when running the wiring and affixing the electrical boxes to the EPS. Panel locations and installation options will also need to be planned for as these also might differ from conventional building techniques.

5.2 MECHANICAL

As with all buildings, the mechanical equipment installed must work efficiently with the type of structure being proposed. Inefficient equipment will result in poor performance of the structure and increased costs to the end user. When sizing any mechanical equipment it is beneficial to calculate, through engineered analysis, the required size of the appropriate equipment.

Consult your local Tremco CPG representative and local accredited bodies.



5.3 PLUMBING

GENERAL

In traditional building methods, plumbing installation practices generally maintain that whenever possible hot and cold supply waterlines should be kept to the interior partition walls or within floor spaces under cabinets, tubs and sinks. With Nudura the same rules will apply. By running the waterlines and any vent stack pipes through interior partition walls will not jeopardize the EPS insulation on the exterior walls and it will reduce the risk of freezing in cold climates. All plumbing codes must be followed with regards to waterlines, vent stack pipes, and waste piping.

There may be a need for installing through wall sleeves and inserts prior to concrete placement for a variety of different mechanical, electrical and plumbing needs. If copper piping is used for water supply, the plumber is cautioned to ensure that all EPS foam is protected from open flame especially if sweating copper joints at or near the foam surface by using sheet metal or other means.

The Nudura Installer and/or Project Supervisor should note that for any Nudura job requiring timber joists, floor trusses or light framed metal floor systems, despite ideal installation conditions as discussed above, the plumber may require access to specific wall locations after the concrete walls have been poured and before the floor system is installed to enable access for any plumbing runs that may need to transition a floor level that is installed inside the Nudura wall. If the plumber cannot access the site before the floor is installed, the Project Supervisor can identify the area where penetrations may be required and install vertical vent pipe sections that extend sufficiently above and below the project floor level to accommodate the plumber's access behind the floor joists at a later date.

WATER SUPPLY

Despite best recommended practices above, should the building design dictate the need to run water lines in the EPS, a chase the size of the piping will be necessary to be cut at the required location The chase can be cut in after the Nudura walls are completed poured and the roof has been finished. This will reduce risk of freeze-up in colder climates. Be sure to keep the piping away from web locations so that there is no danger of fasteners penetrating the pipe.

WASTE WATER DRAINAGE AND VENTS

Consult your local Tremco CPG representative and local professional for installation methods.

5.4 INTERIOR FINISHES

5.41 VAPOUR CONTROL LAYER REQUIREMENTS

As with all traditionally constructed buildings, the interior finishes for a Nudura building can vary throughout the world. What might be very common in one region might not be available in another. As with EPS (expanded polystyrene) the material typically must be covered with a fire barrier if the space is considered habitable by the local building codes.

One of the most common questions asked by both design professionals and building officials with respect to Nudura is whether or not an additional vapour control layer (VCL) is required to be applied over the interior surface.

Based on the testing that has been done on Nadura EPS it performs as a VCL. Depending on local conditions an additional VCL may be required.

Another exception to this condition could apply in areas where high humidity will always be prevalent (i.e. indoor pools or saunas etc.) and where a finish applied may be in danger of trapping moisture behind it such as ceramic tile, vapour sealed paints and wallpapers.

5.42 FIRE BARRIER PROTECTION

Most building codes state that all foam plastic insulation must be covered with an approved fire barrier. Typically plasterboard is considered a fire barrier, but consult local codes and regulations to approved finishes.

Figure 5.01

Figure 5.02

5.43 FINISHING OPTIONS

Before finishes are applied to the wall the contractor/installer needs to take into consideration some additional fastening requirements needed for hand rails, curtain rods, heavy wall hangings (i.e. large mirrors, heavy artwork), upper kitchen cabinets, and handicap bathroom rails. These can consist of solid blocking mechanically fastened to the concrete, or light gauge metal mechanically connected to the fastening strips.

In many instances, the ideal scenario is to rip 100 to 150 mm wide segments of 13 to 15 mm thick plywood for the regions where fastening will be required as noted above (such as horizontally in line with the anchor reinforcement boards of upper cabinets in kitchen areas). Using a hot knife attachment formatted for this purpose, rake any EPS foam clear to the level of the fastening surface of the webs. Then, cut the plywood segments to the required length and screw fasten them with flathead coarse thread screws into the webs of the inset areas that have been raked clear with the hot knife. You now have solid continuous fastening exactly in line with whatever trade arrives after the drywall trades have finished their work and no disruption or special requirements imposed on the drywall contractor.

Nudura recommends that the interior finish materials used be mechanically connected to the fastening strips using screws. Should the contractor decide to use 12,5 mm plasterboard, Nudura recommends the wall board be fastened onto the wall using a 42 mm minimum coarse thread drywall screw. For all other finishes the manufacturer's installation instructions need to be followed. However, if the manufacturer recommends the finish be nailed in place, contact the local distributor for assistance and Nudura will work with the finishing company to find a suitable type of screw for fastening.

For interior finishing of trims and skirting boards consult your local Tremco CPG representative or professional.

Figure 5.03

Figure 5.04

Figure 5.05

5.44 POST OCCUPANCY FIXTURE MOUNTING TIPS FOR HOME AND BUILDING OWNERS

Once an owner takes occupancy, if a contractor should ever be asked for anchorage tips on how to work with Nudura for a home renovation or "Do It Yourself" job, refer to the following pages. This answers most typical questions posed by building owners on this subject. Any additional questions not addressed by this bulletin can be directed to your local Tremco CPG representatve or through your local distributor.

NOTE TO THE CONTRACTOR

The following information is provided here in your manual to assist you in addressing questions from your end use client who may be encountering living/working in a Nudura home or building for the first time and may not be fully familiar with the differences between traditional building and Nudurain the context of adding decorations, fixtures or cabinets to their new home or building.

POST INSTALLATION FIXTURE AND CABINET ATTACHMENT METHODS INTO FINISHED NUDURA WALL ASSEMBLIES

Unlike traditional traditional construction, the plan view of a Nudura wall looks similar to the detail shown at right. At 203 mm intervals, there are a series of vertically placed 38 mm wide x 5 mm thick plastic web fastening strips (each embedded below the surface of the EPS foam about 15 mm. This plastic is capable of holding screws to an ultimate direct pullout withdrawal pressure of anywhere between 0.9 to 1.2 kN of force.

Q: HOW DO I TELL WHERE A FASTENING STRIP IS LOCATED?

Either an electronic or magnetic stud finder is the appropriate tool to locate fastening strips.

Q: FOR LIGHTWEIGHT PICTURES, ETC. CAN I STILL USE NAIL OR PIN TYPE HANGERS ?

Yes: Most light or medium duty plasterboard type picture hangers that do not rely on anchorage directly into the plastic webs can still be used with Nudura walls as well. Finishing nail, pin hangers, plastic plugs, even expansion sleeve screws etc. will all still work with Nudura when anchoring into plasterboard between the webs. Only spring type clip fasteners that relying on spring loaded cams opening behind the plasterboard finish will not work with Nudura since the EPS foam will prevent the cam from springing outward behind the panel.

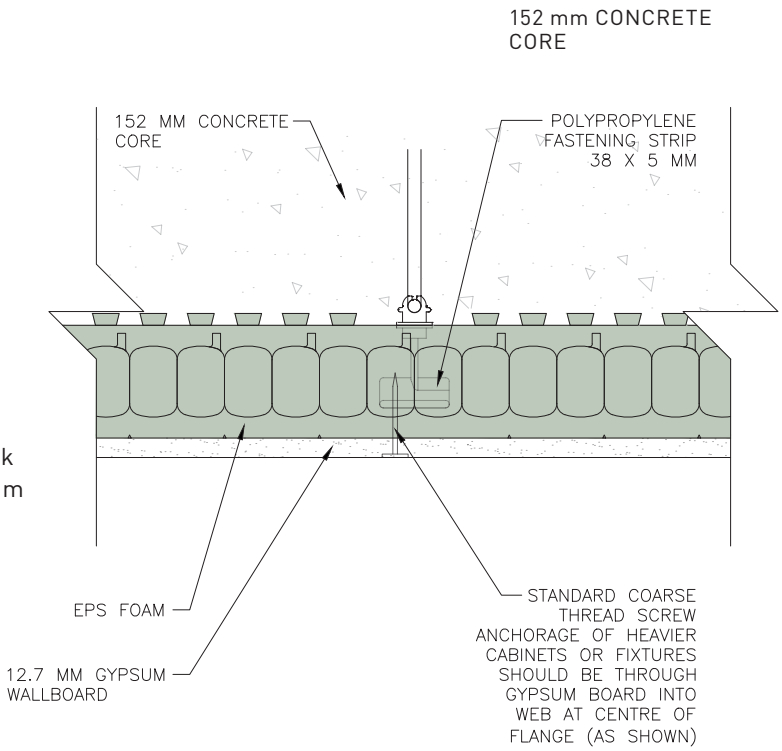


Figure 5.06

Q: FOR HEAVIER WEIGHT ARTWORK, WALL DECORATIONS OR FIXTURES, ETC. WHAT SHOULD BE USED ?

Screws (not nails) with a sharp penetration point should be used. Remember that the shaft length needs to long enough to penetrate the plasterboard, 15 mm of EPS an the 5 mm plastic web. The larger diameter the screw - the more holding power can be attained. Refer to our ETA (European Technical Assesment) for appropriate fixing.

When fastening - simply snug the screw against whatever is being mounted over the plasterboard. If a finish harder than plasterboard is used - do not over-tighten screws as this can cause the screw to strip out the plastic of the webs.

Q: I AM MOUNTING A CLOSED IN BACK CABINET WHICH WILL EXERT MORE WEIGHT PER SCREW THAT I SEE IN THE ABOVE TABLE. HOW CAN I MOUNT THIS TYPE OF CABINET?

If a new cabinet or similar heavy storage device is being considered for mounting (i.e. an object with a closed backing and solid wood or metal mounting bars or brackets) and you calculate that 4 screws will not be enough to anchor the object, consider replacing the plasterboard with plywood behind the cabinet.

Q: I AM MOUNTING A FLAT TV WHICH WILL EXERT MORE WEIGHT PER SCREW THAT I SEE IN THE ABOVE TABLE. HOW CAN I MOUNT THIS TYPE OF FIXTURE?

If it is a TV mounting bracket that is being anchored, use the mounting bracket as a template and align the wall mount studs of the mounting bracket with the Nudura fastening strips. Most mounting studs will provide options for more than 2 screws (vertically in line) per mount. Follow the instructions provided for your mounting bracket.

Q: WHAT IF WHAT I AM ANCHORING IS TO A SINGLE POINT 0.09 METER AND ANTICIPATING A FORCE IN EXCESS OF 1.6 KN?

In instances like this, again the plasterboard may have to be removed and replaced with a square of plywood so that the plywood segment spans at least 2 fastening strips. Anchor the plywood with the appropriate number of countersunk screws to resist the weight.

If even more anchorage strength is required, consider the above solution in conjunction with removal of the foam below the plywood and custom cut timber mounted directly to the concrete.

Any questions further to this information should be directed to your local Tremco CPG representative or Nudura distributor.

6.0 Exterior Finishes

6.1 GENERAL

Nudura can be covered with a multitude of different finishes. Exterior finishes must be installed over the EPS as per manufacture´s instructions and in accordance with the building code and local requirements. The exterior finish will protect the EPS from weathering. Exterior finishes may include brick, stone, timber, cement board, render, metal, U-PVC, brick slips etc.

MOST IMPORTANT: All exterior finishes requiring mechanical attachment will require the use of SCREWS in place of any nails that are specified in the manufacturer's installation instructions.

An area of finishing that needs special attention will be around the openings. Nudura recommends using illbruck i3 system to ensure air- and watertightness and isulation. Consult Tremco CPG representative.

Check local building code requirements for use of weather resistive barrier before installing an exterior finish on Nudura ICF.

Figure 6.01

In the event that, for purposes of any local code compliance issues, or the project design architect should specify an additional air barrier to be installed on the exterior building face as either a water resistive barrier or second defense air barrier, materials that are acceptable for use with the Nudura must not be petroleum based. Over time, these materials can potentially leach chemicals into the EPS that may react with the EPS resin. Acceptable products that are available as alternates for this purpose include illbruck membrane solutions or similar. Consult the local Tremco CPG representative.

The damp proof membrane can be sealed to the wall using ETICS base coating mesh.

Figure 6.02

Figure 6.03

TREMCO

Construction Products Group

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The product brands housed within Tremco CPG Europe cover a wide array of different construction needs and provide a wealth of complex services, support and systems that are rarely found together under one roof.

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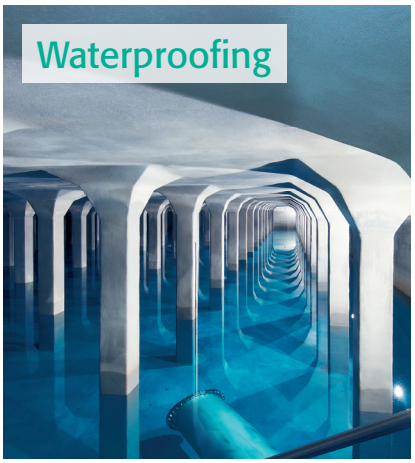

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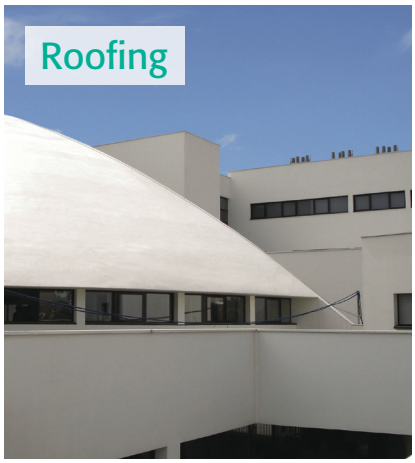

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