BRICK LEDGE BEARING CAPACITY DOCUMENTION

FOR

NUDURA™ INTEGRATED BUILDING TECHNOLOGY
INSULATED CONCRETE FORMS

NOTE:

ON NOV 1st, 2002, THE COMPANY FORMERLY KNOWN AS "AIM BUILDING PRODUCTS INC."
BECAME INCORPORATED UNDER THE COMPANY NAME OF "NUDURA CORPORATION"

May 13, 2005

TO: ALL ARCHITECTS, ENGINEERS, CONTRACTORS AND BUILDING OFFICIALS

RE: <u>BEARING CAPACITY OF CORBELLED LEDGES FORMED WITH NUDURA BRICK LEDGE FORM UNITS AND BRICK LEDGE EXTENSIONS</u>

The attached documentation has been prepared to assist our distributors in helping our key client groups better understand the structural capabilities of performance of NUDURA's Extended Brick Ledge Form Unit as well as the NUDURA Brick Ledge Extension.

The Extended Brick Ledge Form Unit and Brick Ledge Extension Form have been designed by NUDURA's product engineers to provide a structurally reinforced 4 ½" (114mm) corbel stand-off from the face of any cavity width of NUDURA's typical form units that will enable structural bearing of standard thicknesses of brick, block, or stone for heights specified below. As the attached documentation verifies, the ledge when constructed as specified is capable of supporting standard 3 ½" (89mm) thick brick or stone installed to a height of 27 feet (8.23 meters). The geometry of the ledge and reinforcing hook stirrup have been designed in accordance with the provisions of Section 11.9 (Special Provisions for Brackets and Corbels) of ACI 318 (USA) and with Section 11.5 (Strut and Tie Model) and Section 11.7 (Special Provisions for Brackets and Corbels) of CAN/CSA A23.3 (CAN) (copies of these documents if not accompanying this documentation are available from NUDURA through our distributors).

The attached letter from Trow Consulting Engineers (originally issued to NUDURA Corporation under its former corporate name of AIM Building Products) corroborates an ultimate (un-factored load) bearing capacity of 6,800 pounds/linear foot (100 kilo Newtons/meter). This ultimate capacity is based on the use of 3,000 psi (20 MPa) concrete and reinforcing with minimum #4 (10M) reinforcing bar and hook stirrups as detailed utilizing minimum 60 ksi (Grade 400) steel.

However, the brick ledge's factored safe load capacity is recommended to be well below this loading limit. As noted in the letter from Trow Engineering – brick or stone can be safely be installed to a maximum of 3 stories in height or 27 feet (8.23 m) (as noted in the stamped brick ledge detail also attached).

Given this stated height limit and that the density of stone being set at approx. 165 lbs/ft^3 (2,611 kg/m^3) and that the stone is assumed to be exactly 3 ½" (89mm) thick, as such the stone will have a correlated unit weight of approx. 50 lbs/ft^2 (807.3 kg/m^2) of finished wall area. Therefore, the factored safe load limit of the NUDURA brick ledge is set at approximately 1,350 lbs/lf (2013 kg/m) yielding a 5.037 safety factor in comparison to ultimate load capacity stated by Trow Engineering.

For Brick installations requiring masonry support ABOVE the height of 27 feet (8.23 meters), the connection shown in Detail D4 can be used which consists of a standard structural steel support angle connected with embedded bolts back into the wall cavity in accordance with the applicable table sized and spaced in accordance with the required height of wall. This connection then assures transference of the load through the angle bolts back into the wall condition itself as opposed to bearing directly on the corbelled ledge. Conditions beyond those shown will require professional engineer's review

Often the question is raised as to the suitability of the ledge to be used as a floor bearing ledger when inverted to the interior as show in the attached Detail No. C6A14 (final attachment).

This type of application can safely be considered for one or two story floor bearing conditions in low risk seismic areas (Seismic D and below –USA, Seismic Z_a or $Z_v \leq 4$ -CAN), so long as the calculated combined factored dead and live load totals do not exceed the above noted bearing limit of 1,350 lbs/lf (2013 kg/m) bearing on the ledge. Anchorage of the floor assembly into the top of the wall must be also in full accordance with applicable local codes (i.e. nailing and sill bolting) to assure that the wall is properly connected to and stayed in place by the floor diaphragm. NOTE: You must consult with a professional engineer if considering applications outside of these limits for seismic, load or any other custom or specialized conditions not noted above - for span limits and anchorage requirements. DO NOT consider utilizing a brick ledge for bearing a concrete floor of any kind without consulting with a structural engineer as to whether the application is suitable.

Any other questions that may arise regarding brick ledge capacity and applications can be directed to NUDURA Technical Support through your local NUDURA distributor.

Trow Consulting Engineers Ltd
Parent Company of Oliver; Mangione, McCalla & Associates
1100 Marleau Ave.
Cornwall, Ontario K6H 2W8
Telephone: (613) 938-9973
Facsimile: (613) 938-4988

Reference: MU15730AW

August 28, 2002

Mr. Alain C Leger P.Eng.
Ottawa Regional Office
AIM Building Products
P.O. Box 189
Long Sault, Ontario
K0C 1P0

Dear Mr. Leger:

Capacity of Brick Ledge Unit

We have determined the capacity of the brick ledge unit faxed to us on June 12, 2002. We are able to report that the maximum, unfactored, uniformly distributed load (UDL) that can be supported by the brick ledge is 100 kN/m (6.8 kip/ft). However, this value shall never be considered alone in the design of any combination of building components due to the number of other facotrs involved, such as, but not limited to the following:

- Axial and flexural capacity of wall (limited by cross-sectional properties, height, reinforcement, etc.),
- Capacity of footings,
- Capacity of soil,
- Capacity of any and all other components in load path,
- Seviceability criteria (e.g. deflection, cracking, etc.)

Calculations were performed only for the 150mm (6") nominal concrete core and various assumptions were made. These assumptions are that the concrete compressive strength is 20 MPa, reinforcement consists of Grade 400, #10M bars, no horizontal forces are applied to the ledge, an unreinforced brick wall of specified unit weight of 1.9 kPa and the ties are located at 200mm c/c.

Brick ledge capacity shall always be reviewed by a structural engineer when proposed use is other than a "brick ledge" supporting more than 3 storeys of brick.

Trow Consulting Engineers Ltd. accepts no responsibility for control of the use of the brick ledge for which we have not been consulted.

We trust that you find the above to your satisfaction and if you have any questions, please feel free to contact the undersigned.

Yours truly,
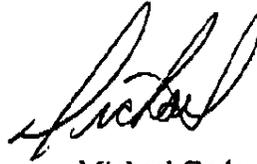
Oliver, Mangione, McCalla & Associates
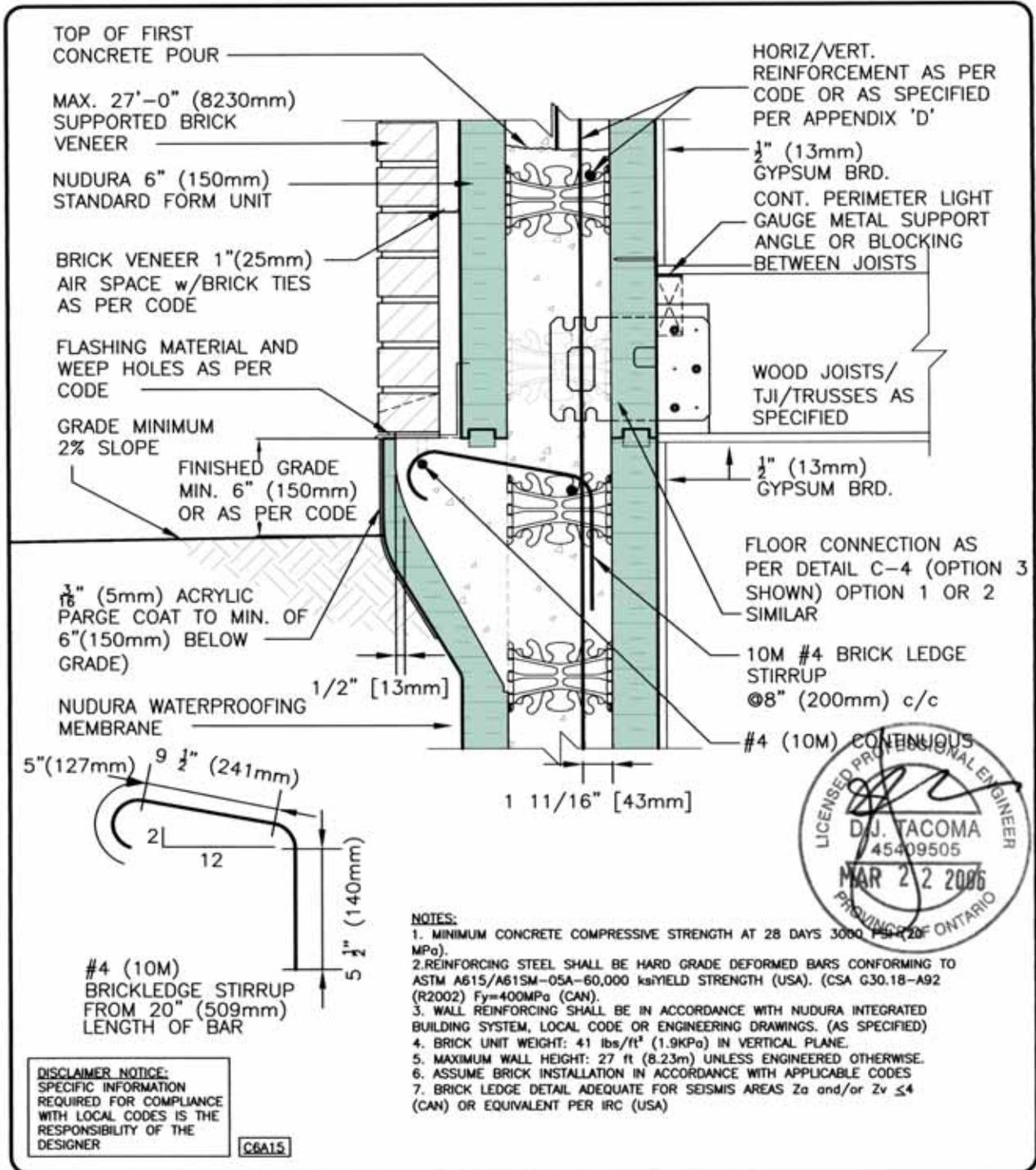**a division of Trow Consulting Engineers Ltd.**

Kevin MacDonald
Associate
Cornwall Office

Michael Godard, *P.Eng.*
Manager,
Cornwall Office

Distribution: File: MU15730AW

C TYPICAL DETAILS (C-5)

TOP OF FIRST
CONCRETE POUR

MAX. 27'-0" (8230mm)
SUPPORTED BRICK
VENEER

NUDURA 6" (150mm)
STANDARD FORM UNIT

BRICK VENEER 1"(25mm)
AIR SPACE w/BRICK TIES
AS PER CODE

FLASHING MATERIAL AND
WEEP HOLES AS PER
CODE

GRADE MINIMUM
2% SLOPE

FINISHED GRADE
MIN. 6" (150mm)
OR AS PER CODE

$\frac{3}{16}$" (5mm) ACRYLIC
PARGE COAT TO MIN. OF
6"(150mm) BELOW
GRADE)

$\frac{1}{2}$" [13mm]

NUDURA WATERPROOFING
MEMBRANE

HORIZ/VERT.
REINFORCEMENT AS PER
CODE OR AS SPECIFIED
PER APPENDIX 'D'

$\frac{1}{2}$" (13mm)
GYPSUM BRD.

CONT. PERIMETER LIGHT
GAUGE METAL SUPPORT
ANGLE OR BLOCKING
BETWEEN JOISTS

WOOD JOISTS/
TJI/TRUSSES AS
SPECIFIED

$\frac{1}{2}$" (13mm)
GYPSUM BRD.

FLOOR CONNECTION AS
PER DETAIL C-4 (OPTION 3
SHOWN) OPTION 1 OR 2
SIMILAR

10M #4 BRICK LEDGE
STIRRUP
@8" (200mm) c/c

#4 (10M) CONTINUOUS

1 11/16" [43mm]

5"(127mm) 9 $\frac{1}{2}$" (241mm)

2 / 12

5 $\frac{1}{2}$" (140mm)

#4 (10M)
BRICKLEDGE STIRRUP
FROM 20" (509mm)
LENGTH OF BAR

DISCLAIMER NOTICE:
SPECIFIC INFORMATION
REQUIRED FOR COMPLIANCE
WITH LOCAL CODES IS THE
RESPONSIBILITY OF THE
DESIGNER

C6A15

NOTES:
1. MINIMUM CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS 3000 PSI (20
MPa).
2. REINFORCING STEEL SHALL BE HARD GRADE DEFORMED BARS CONFORMING TO
ASTM A615/A61SM-05A-60,000 ksiYIELD STRENGTH (USA). (CSA G30.18-A92
(R2002) Fy=400MPa (CAN).
3. WALL REINFORCING SHALL BE IN ACCORDANCE WITH NUDURA INTEGRATED
BUILDING SYSTEM, LOCAL CODE OR ENGINEERING DRAWINGS. (AS SPECIFIED)
4. BRICK UNIT WEIGHT: 41 lbs/ft² (1.9KPa) IN VERTICAL PLANE.
5. MAXIMUM WALL HEIGHT: 27 ft (8.23m) UNLESS ENGINEERED OTHERWISE.
6. ASSUME BRICK INSTALLATION IN ACCORDANCE WITH APPLICABLE CODES
7. BRICK LEDGE DETAIL ADEQUATE FOR SEISMIS AREAS Za and/or Zv ≤4
(CAN) OR EQUIVALENT PER IRC (USA)

LICENSED PROFESSIONAL ENGINEER
D.J. TACOMA
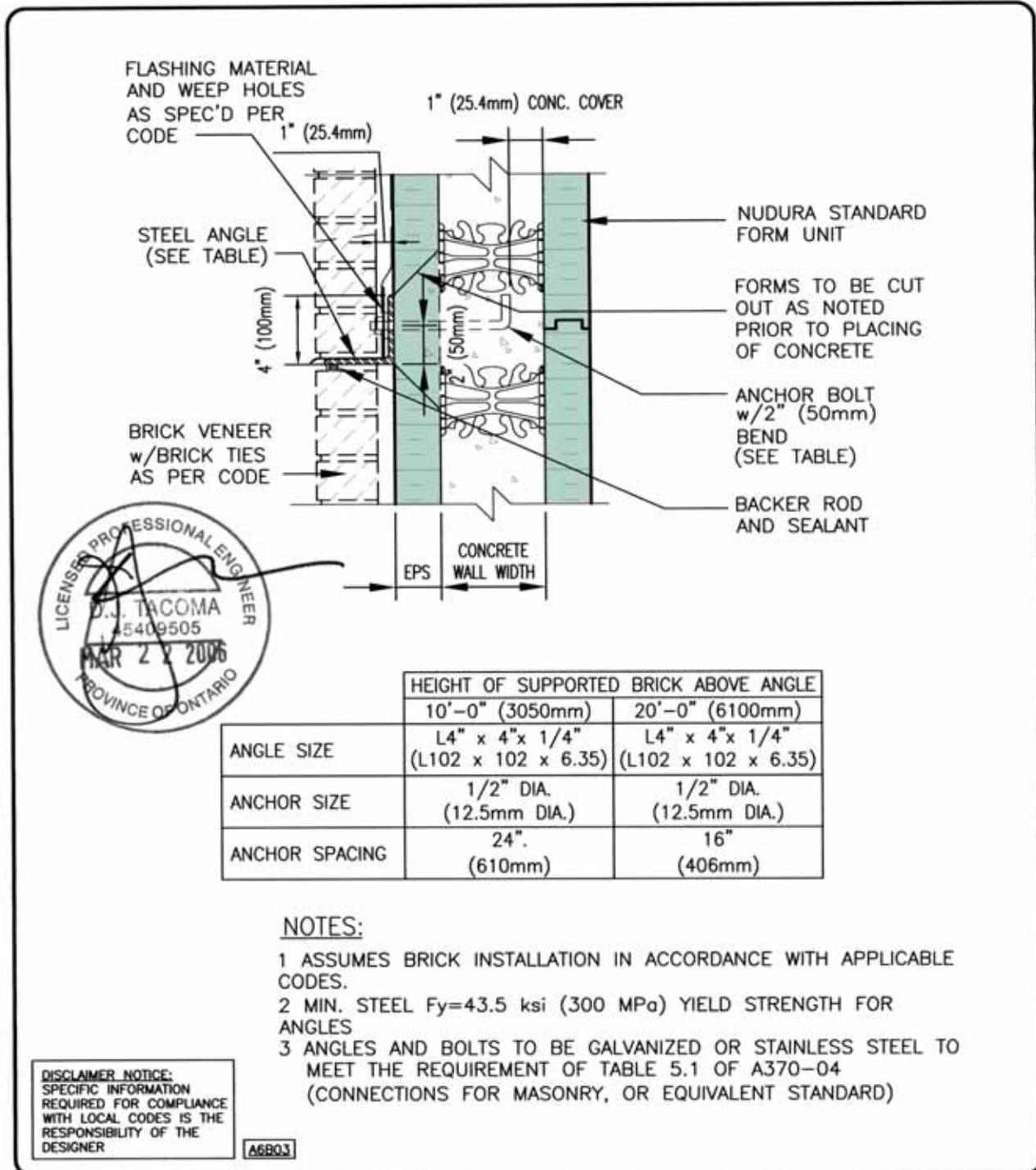45409505
MAR 2 2 2006
PROVINCE OF ONTARIO

NUDURA ®
INTEGRATED BUILDING TECHNOLOGY
Building Value.

6" MOLDED BRICK LEDGE DETAIL
6" FORM ABOVE GRADE
BRICK VENEER FINISH

REV. NO. 003 TV	DWG NO.
REV. DATE: JAN 2006	C-5
DRAWN BY: J.N / N.L	SCALE: "Not to Scale"

C   TYPICAL DETAILS (C-10)

FLASHING MATERIAL
AND WEEP HOLES
AS SPEC'D PER
CODE — 1" (25.4mm)

1" (25.4mm) CONC. COVER

STEEL ANGLE
(SEE TABLE)

4" (100mm)

2" (50mm)

BRICK VENEER
w/BRICK TIES
AS PER CODE

EPS   CONCRETE
WALL WIDTH

NUDURA STANDARD
FORM UNIT

FORMS TO BE CUT
OUT AS NOTED
PRIOR TO PLACING
OF CONCRETE

ANCHOR BOLT
w/2" (50mm)
BEND
(SEE TABLE)

BACKER ROD
AND SEALANT

	HEIGHT OF SUPPORTED BRICK ABOVE ANGLE	
	10'-0" (3050mm)	20'-0" (6100mm)
ANGLE SIZE	L4" x 4"x 1/4" (L102 x 102 x 6.35)	L4" x 4"x 1/4" (L102 x 102 x 6.35)
ANCHOR SIZE	1/2" DIA. (12.5mm DIA.)	1/2" DIA. (12.5mm DIA.)
ANCHOR SPACING	24". (610mm)	16" (406mm)

NOTES:

1 ASSUMES BRICK INSTALLATION IN ACCORDANCE WITH APPLICABLE CODES.
2 MIN. STEEL Fy=43.5 ksi (300 MPa) YIELD STRENGTH FOR ANGLES
3 ANGLES AND BOLTS TO BE GALVANIZED OR STAINLESS STEEL TO MEET THE REQUIREMENT OF TABLE 5.1 OF A370-04 (CONNECTIONS FOR MASONRY, OR EQUIVALENT STANDARD)

DISCLAIMER NOTICE:
SPECIFIC INFORMATION
REQUIRED FOR COMPLIANCE
WITH LOCAL CODES IS THE
RESPONSIBILITY OF THE
DESIGNER

A6B03

NUDURA®
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Building Value.

BRICK SHELF ANGLE
BACK OF ANGLE FLUSH
WITH E.P.S. EXTERIOR
(MULTI-STORY APPLICATION)
PRE-INSTALLATION MOUNT

REV. NO. 002 TV	DWG NO.
REV. DATE: JAN 2006	C-10
DRAWN BY J.N / N.L	SCALE: "Not to Scale"

C   TYPICAL DETAILS (C-11)

HILTI ANCHORS TO BE SIZED AS PER TABLE

NOTE: MAINTAIN u/s OF ANCHOR SHAFT 2" (50mm) min. CLEARANCE FROM WEBS AND 1"(25mm) COVER ALL AROUND

1" (25.4mm) CONC. COVER

FLASHING MATERIAL AND WEEP HOLES AS SPEC'D PER CODE

4" (100mm)

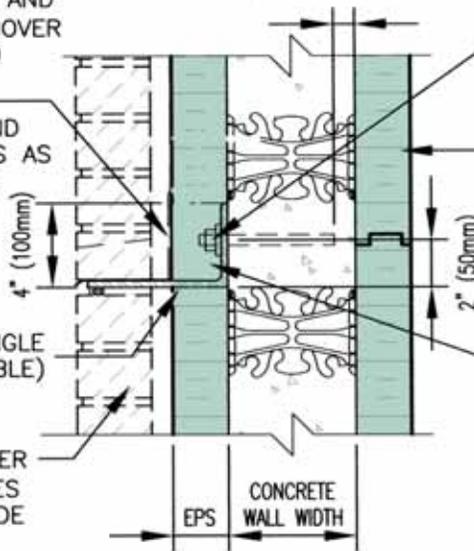2" (50mm)

WEDGE ANCHOR (SEE TABLE)

NUDURA STANDARD FORM UNIT

REMOVE EXISTING EPS AND REPLACE AFTER INSTALLATION OF SHELF ANGLE

STEEL ANGLE (SEE TABLE)

FORM TO BE CUT OUT

BRICK VENEER w/BRICK TIES AS PER CODE

EPS

CONCRETE WALL WIDTH

ANGLE SIZE	HEIGHT OF SUPPORTED BRICK ABOVE ANGLE	
	10'-0" (3050mm)	20'-0" (6100mm)
ANGLE SIZE	L6" x 4" x 5/16" (L152 x 102 x 7.9)	L6" x 4" x 3/8" (L152 x 102 x 9.5)
ANCHOR SIZE */ EMBEDMENT	HSL M12/25 3.2" (80mm)	HSL M16/25 4.2" (105mm)
ANCHOR SPACING	16" (406mm)	16" (406mm)

* ANCHORS SPECIFIED ABOVE ARE HILTI HEAVY DUTY ANCHORS

NOTES:

1 CONTRACTOR TO INSTALL ANCHORS AS PER SUPPLIER'S SPECIFICATIONS.
2 ASSUMES BRICK INSTALLATION IN ACCORDANCE WITH APPLICABLE CODES.
3 MIN. STEEL Fy=43.5 ksi (300 MPa) YIELD STRENGTH FOR ANGLES
4 ANGLES AND BOLTS TO BE GALVANIZED OR STAINLESS STEEL TO MEET THE REQUIREMENT OF TABLE 5.1 OF A370-04 (CONNECTIONS FOR MASONRY, OR EQUIVALENT STANDARD)
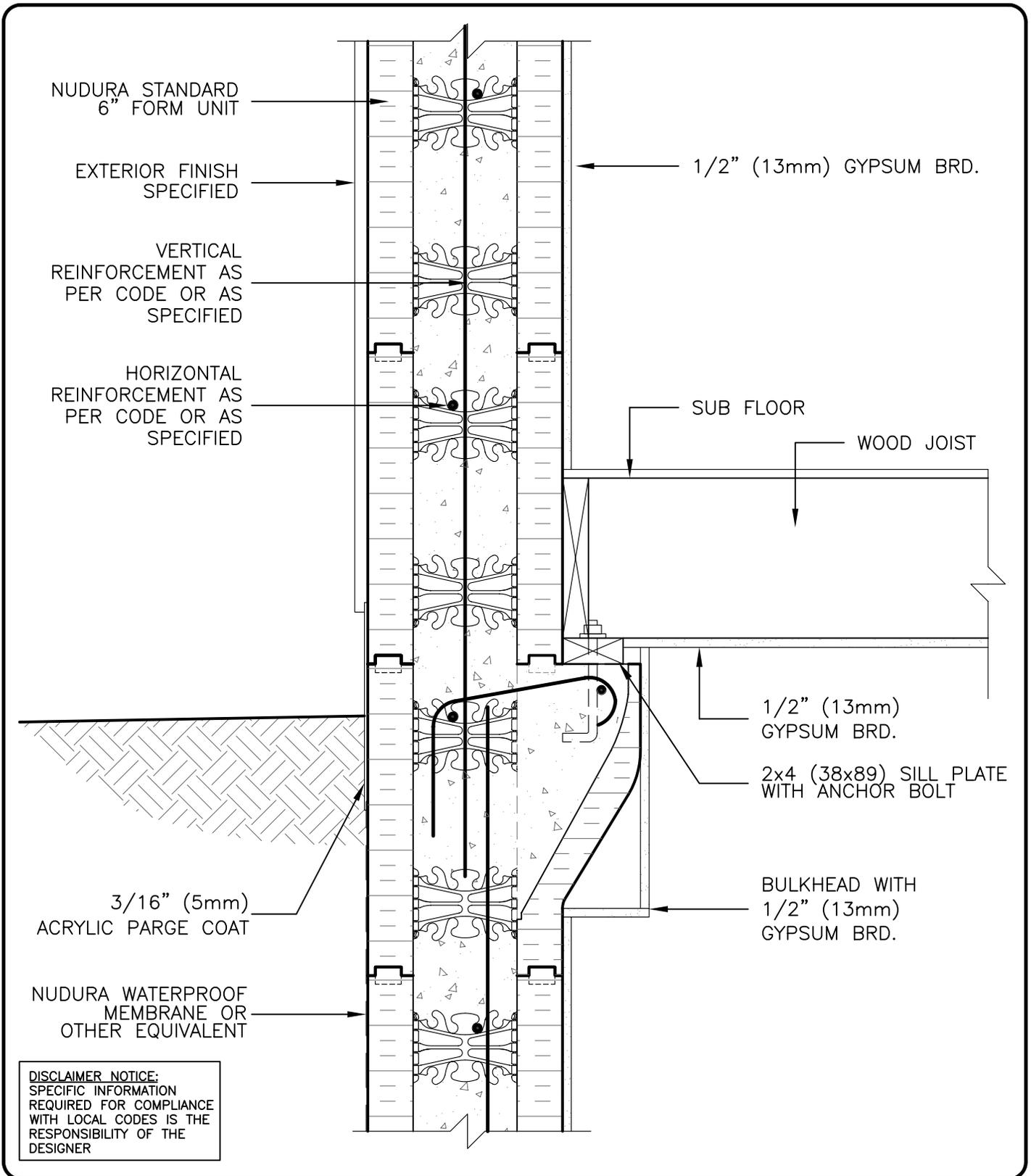
LICENSED PROFESSIONAL ENGINEER
D.J. TACOMA
45409505
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Building Value.

BRICK SHELF ANGLE BACK OF ANGLE FLUSH WITH CONCRETE (POST INSTALLATION MOUNT)

REV. NO. 002 TV	DWG NO. C-11
REV. DATE: JAN 2006	
DRAWN BY J.N / N.L	SCALE: "Not to Scale"

NUDURA STANDARD
6" FORM UNIT

EXTERIOR FINISH
SPECIFIED

VERTICAL
REINFORCEMENT AS
PER CODE OR AS
SPECIFIED

HORIZONTAL
REINFORCEMENT AS
PER CODE OR AS
SPECIFIED

1/2" (13mm) GYPSUM BRD.

SUB FLOOR

WOOD JOIST

1/2" (13mm)
GYPSUM BRD.

2x4 (38x89) SILL PLATE
WITH ANCHOR BOLT

BULKHEAD WITH
1/2" (13mm)
GYPSUM BRD.

3/16" (5mm)
ACRYLIC PARGE COAT

NUDURA WATERPROOF
MEMBRANE OR
OTHER EQUIVALENT

NUDURA

INTEGRATED BUILDING TECHNOLOGY

Building Value.

STANDARD 6" FORM UNIT
BRICK LEDGE SUPPORTING JOISTS
EXTERIOR FINISH SPECIFIED
PERP. TO WALL

REV. NO. 001	DWG NO. C6A14
REV. DATE: MAY 2005	
DRAWN BY: J.N / N.L	SCALE: 1 1/2"=1'-0"