



30 GREEN CONSTRUCTION DETAILS 30 DETALLES CONSTRUCTIVOS VERDES

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Puerto Rico

Disclaimer: Most of the details shown in this publication have been put to practice in actual construction applications. Nevertheless, because of the multiple conditions and circumstances affecting a construction job, the author cannot assume any responsibility for the application of them.

You can obtain more information related to the material contained in this book through the following internet web sites:

1. www.usgbccaribbean.org
2. www.construction.com/Sweets/GreenManufacturers/
4. Greensage Directory of Green Products
www.greensage.com/directoryspl.html
5. Wall & Roof R Value Calculator
www.asianz.co.nz/CRC CalculatorFrame
6. www.treehugger.com/
7. www.nrel.gov

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Adapt details according to your climatic conditions and specific job.

This book is bound on the upper margin to permit notes on the back side of each sheet while at the same time have the reference detail visible.

Develop your own details and send a copy to us. If we find them helpful and publishable we will reward your efforts with a copy of the next edition of this book.

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El arquitecto Fernando Abruña tuvo la gentileza y generosidad de compartir este valioso documento con nosotros.
Haga buen uso de él y otorgue los créditos que corresponden.

Muchas gracias

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GREEN CONSTRUCTION DETAILS

A collection of ideas for sustainable construction fully illustrated and simply explained.

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How to use this Book

- Read the short chapter "Frame of Reference" to get a general idea for the subject matter.
- Photocopy appropriate details only for your personal use.
- Adapt details according to your climatic conditions and specific job.
- Develop your own details and send a copy to us. If we find them helpful and publishable we will reward your efforts with a copy of the the next edition of this book.

Learning Objectives

- Introduce the reader to the pragmatic issues of green design and construction based on the more general concepts of sustainability.
- Understand the frame of reference to be used when developing construction details for sustainable buildings.
- Present 30 Green Construction Details applicable to many architectural projects.

DETALLES CONSTRUCTIVOS VERDES

Una colección de ideas para la construcción sostenible ilustradas y simplemente explicadas.

INDICE

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Cómo usar este manual

- * Lea el corto capítulo "Marco de Referencia" para obtener una idea general del tema.
- * Copie detalles sólo para su uso personal
- * Adapte detalles acorde a sus condiciones climáticas y trabajo específico
- * Desarrolle sus propios detalles y envíenos una copia. Si las consideramos un aporte, recompensaremos sus esfuerzos y la incluiremos en la próxima edición.

Objetivos didácticos

- * Introducir al lector en los asuntos pragmáticos del diseño y la construcción verde basados en los conceptos generales de la sostenibilidad.
- * Entender el marco de referencia útil cuando se están desarrollando detalles de la construcción sostenible.
- * Presentar 30 detalles constructivos verdes aplicables a muchos proyectos arquitectónicos.

Frame of Reference / Marco de Referencia

39% of all CO₂ gases are generated by the building industry

39% de los gases CO₂ son generados por la industria de la construcción

FRAME OF REFERENCE

1. Sustainability
2. Sustainable Design
3. Ecological Footprint
4. Carbon Footprint
5. Passive Survivability
6. Passive Transformability
7. Cradle to Cradle
8. New Sustainable Technologies
9. Climate Change Vs. Design

1. Sustainability:

Meet today's needs without adversely affecting the ability of future generations to meet theirs. It is an evolving and contextual concept.

Evolving because what might be considered sustainable today might not be in the future. Contextual because sustainability cannot be measured using the same parameters in different climatic, topographic, cultural and economic contexts among others.

2. Sustainable Design:

Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and its occupants.

Basic Green Building Design Practices:

- Sustainable site planning
- Safeguarding water and water efficiency
- Energy efficiency and renewable energy
- Conservation of materials and resources
- Indoor environmental quality

3. Ecological Footprint:

The amount of bio-productive land required to support our lifestyles. Four acres per person is the corresponding amount per person if all the bio-productive land were to be distributed proportionately among the earth's population. To maintain our standards of comfort and lifestyle we need 24 acres/person.

4. Carbon Footprint

The amount of CO₂ emissions resulting from our consumption patterns, energy use and lifestyles.

MARCO DE REFERENCIA

1. Sostenibilidad
2. Diseño Sostenible
3. Huella Ecológica
4. Huella de Carbón
5. Sobrevivencia pasiva
6. Transformabilidad Pasiva
7. Del Origen al Origen
8. Nuevas Tecnologías Sostenibles
9. Cambio Climático vs Diseño

1. Sostenibilidad:

Conocer las necesidades de hoy sin afectar negativamente la capacidad de las generaciones futuras para satisfacer las suyas. Es un concepto contextual que evoluciona. Contextual porque lo que podría considerarse hoy como sostenible, podría no serlo en el futuro. Contextual porque la sostenibilidad no se puede medir aplicando los mismos parámetros en contextos diferentes en clima, topografía, cultura y economía, entre otros.

2. Diseño Sostenible:

Práctica profesional que reduce significativamente o elimina el impacto negativo de los edificios en el ambiente y sus ocupantes.

Diseño Verde y prácticas básicas de construcción:

- Planificación sostenible del sitio
- Ahorro y eficiencia en el uso del agua
- Eficiencia energética y energías renovables
- Conservación de materiales y recursos
- Calidad ambiental interior

3. Huella Ecológica:

La cantidad de tierra bio-productiva requerida para apoyar nuestros estilos de vida. Si toda la tierra bio-productiva fuese repartida equitativamente, 1.6 hectáreas por persona deberían distribuirse proporcionalmente entre la población mundial. Para mantener nuestro nivel de bienestar y estilo de vida necesitamos 12 hectáreas/persona.

4. Huella de Carbono:

La cantidad de las emisiones de CO₂ resultantes de nuestros patrones de consumo, el uso de energía y

20 to 30 tons/person is very common in industrialized nations.

5. Passive Survivability

A building needs to be designed in such a way that its passive operation can continue, temporarily, when the infrastructure technologies collapse.

6. Passive Transformability

A building design needs to incorporate the possibility of physical transformations and changes in use during its useful lifetime without requiring major demolition or the generation of debris.

7. Cradle to Cradle Concept:

Developed by Chemist Michael Braungart and architect William McDonough in their book, "Cradle to Cradle."

Based on a system of "lifecycledvelopment..we can be "wasteful" if the products we produce go completely back into nature or are completely reborn as newproducts. "

Using a cherry tree as an example, they note how "wasteful" it is. Each year it dumps a great pile of fruit and leaves on the ground to rot. But all of this waste goes back into nature to be reborn as new trees, bacteria, birds and other parts of the natural ecosystem. We should try to emulate this natural system instead of trying to do more with less.

8. New Sustainable Technologies

Technological expectations based on recent research include, among others:

1. CO₂ Sequestering Materials
2. Witricity (Wireless Electricity)
3. Polarized Paints (Paints that turn dark in winter and light in summer)
4. Spray On Organic Photovoltaics "

9. Global Warming Vs. Architectural

Design Climate change triggered by Global Warming could possibly alter passive design strategies: i.e.- Natural Ventilation, Humidity Controls, others.

estilos de vida, es de 20 a 30 ton/persona es muy común en las naciones industrializadas.

5. Supervivencia Pasiva

Un edificio debe diseñarse de manera que su operación pasiva pueda continuar, de forma temporal, cuando las tecnologías de la infraestructura colapsan.

6. Transformación Pasiva:

El diseño del edificio necesita incorporar la posibilidad de transformaciones físicas y cambios en el uso durante la vida útil sin mayor demolición o la generación de residuos.

7. Concepto del Origen al origen:

Desarrollado por el químico Michael Braungart y el arquitecto William McDonough en el libro "From Cradle to Cradle".

Basado en un sistema de "desarrollo del ciclo de vida... puede evitarse el desperdicio si los productos que manufacturamos retornan a la naturaleza o renacen como nuevos productos."

Tomando un árbol de cerezo como ejemplo, observaron cuánto "desperdicio" tenía. Cada año se cae una gran cantidad de frutas y hojas sobre el terreno y se pudren. Estos residuos retornan a la naturaleza para renacer como nuevos árboles, bacterias, aves y demás partes del ecosistema natural. Tratemos de emular este sistema natural en lugar de intentar hacer más con menos.

8. Nuevas Tecnologías Sostenibles

Las expectativas tecnológicas, basadas en estudios recientes incluyen entre otras:

1. Materiales secuestradores de carbono
2. Inalambricidad (electricidad sin cables)
3. Pinturas polarizadas (se oscurecen en invierno y se aclaran en verano)
4. Aerosoles fotovoltaicos orgánicos

9. Calentamiento Global vs Arquitectura

El diseño basado en el clima forzado por el calentamiento global posiblemente deba cambiar sus estrategias pasivas de diseño: ventilación natural, control de la humedad y otros.

Prevailing temperatures, breezes and relative humidity in some areas of the planet might change drastically so as to alter the design strategies we have grown accustomed.

Las temperaturas prevalecientes, brisas y humedad relativa en ciertas áreas del planeta pueden variar drásticamente y alterar las estrategias de diseño con las cuales hemos crecido.

U= Successfully Used / Utilizado con éxito

D= Designed / Diseñado

S= Studied or Observed / En estudio - observado

SweetsGreen Collection

Are you working on green buildings? These manufacturers have included green information in their Sweets program to help you learn more about their green products, how they are used in sustainable design, and the manufacturer's own green practices. Follow the links below to the manufacturer's program and look for Green Info in the Company Resources section.

section	company name	1 2 3 4 5 6
---------	--------------	---

03 01 00 Maintenance of Concrete


[Duron Paints & Wallcoverings](#)

03 05 00 Common Work Results for Concrete


[CEME-TUBE, LLC](#)

[L&M Construction Chemicals, Inc.](#)

[OldCastle Precast Inc.](#)

03 10 00 Concrete forming and Accessories

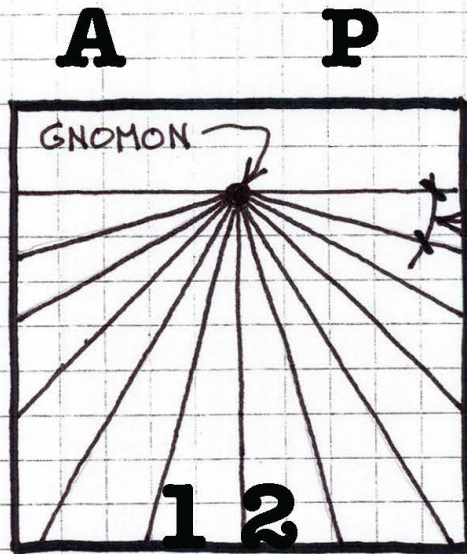

[CEME-TUBE, LLC](#)

[OldCastle Precast Inc.](#)

More information on Green
Construction Details at
[www.construction.com/
Sweets/GreenManufacturers/](http://www.construction.com/Sweets/GreenManufacturers/)

GREEN CONSTRUCTION DETAILS

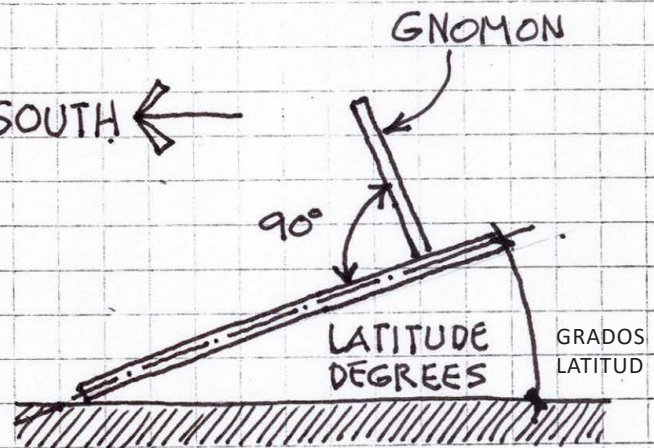
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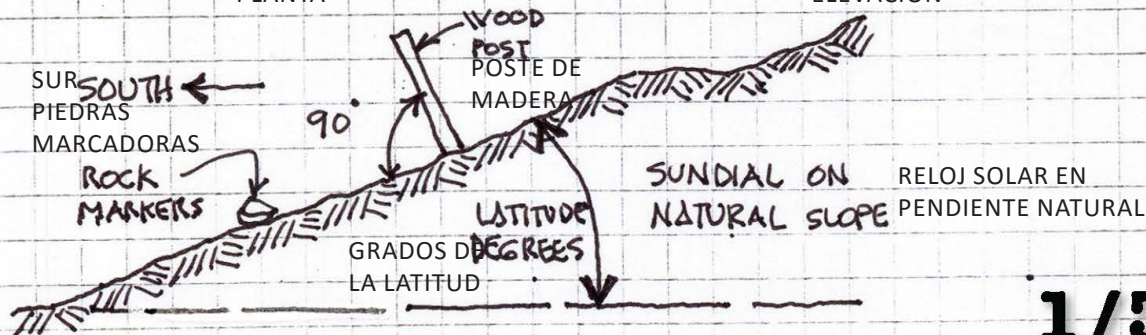
PLAN VIEW
PLANTA

15° INTERVALS
(TYPICAL)
15° INTERVALOS TÍPICO

SOUTH ←



SECTION VIEW
ELEVACIÓN



SUNDIAL DETAIL
DETALLE DEL RELOJ SOLAR

1/30

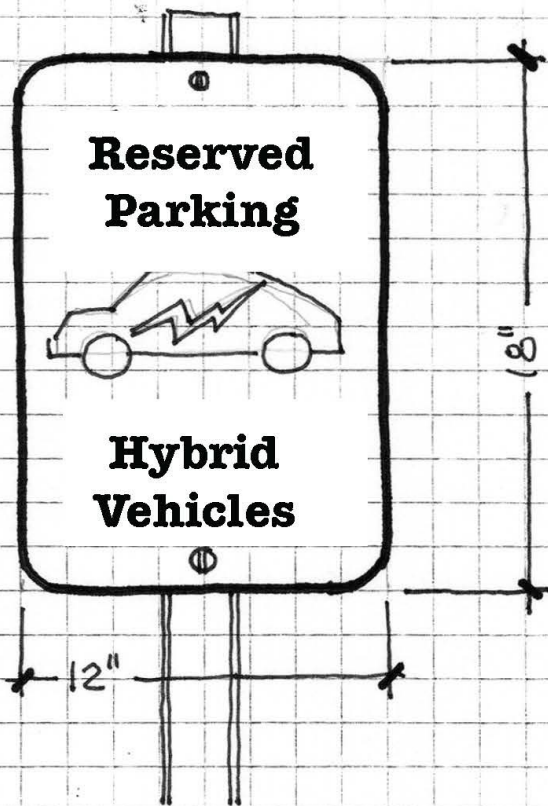
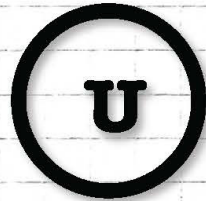
NOTES

- SUNDIALS HAVE MULTIPLE APPLICATIONS IN PUBLIC AREAS, ARE EASY TO ERECT AND NEED VERY LITTLE MAINTENANCE

EN ÁREAS PÚBLICAS, LOS RELOJES SOLARES TIENEN APLICACIONES MÚLTIPLES, SON FÁCILES DE CONSTRUIR Y NECESITAN POCO MANTENIMIENTO

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GREEN CONSTRUCTION DETAILS



HYBRID VEHICLE PARKING SIGN

ESTACIONAMIENTO PARA VEHICULOS HIBRIDOS

2/30

NOTES

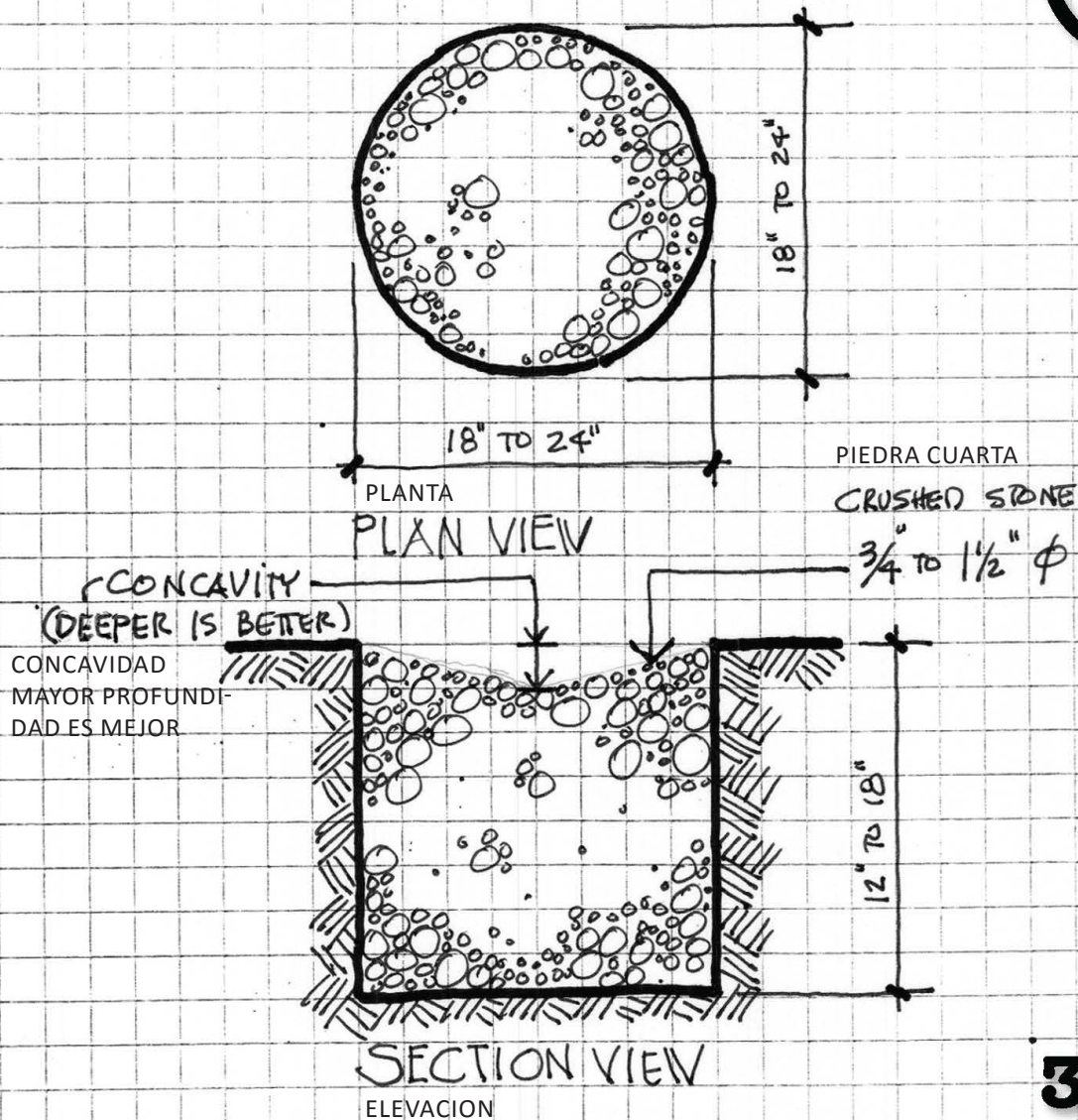
- THESE SIGNS ARE NOT YET STANDARDIZED ...
USE YOUR DESIGN TALENT AND IMAGINATION!
- SIMILAR SIGNS MAY BE USED FOR BYCICLE RACKS AND
ALTERNATIVE FUEL AND ELECTRIC VEHICLES.

ESTA SEÑALIZACIÓN NO HA SIDO IMPLEMENTADA
USE SU TALENTO CREATIVO E IMAGINACIÓN

RÓTULOS SIMILARES SE PUEDEN USAR PARA BICICLETAS Y VEHÍCULOS ALTERNATIVOS

GREEN CONSTRUCTION DETAILS

U



SPLASH PIT DETAIL

DETALLE CAÑO PLUVIAL

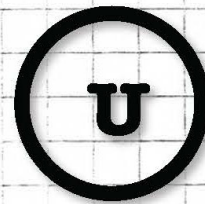
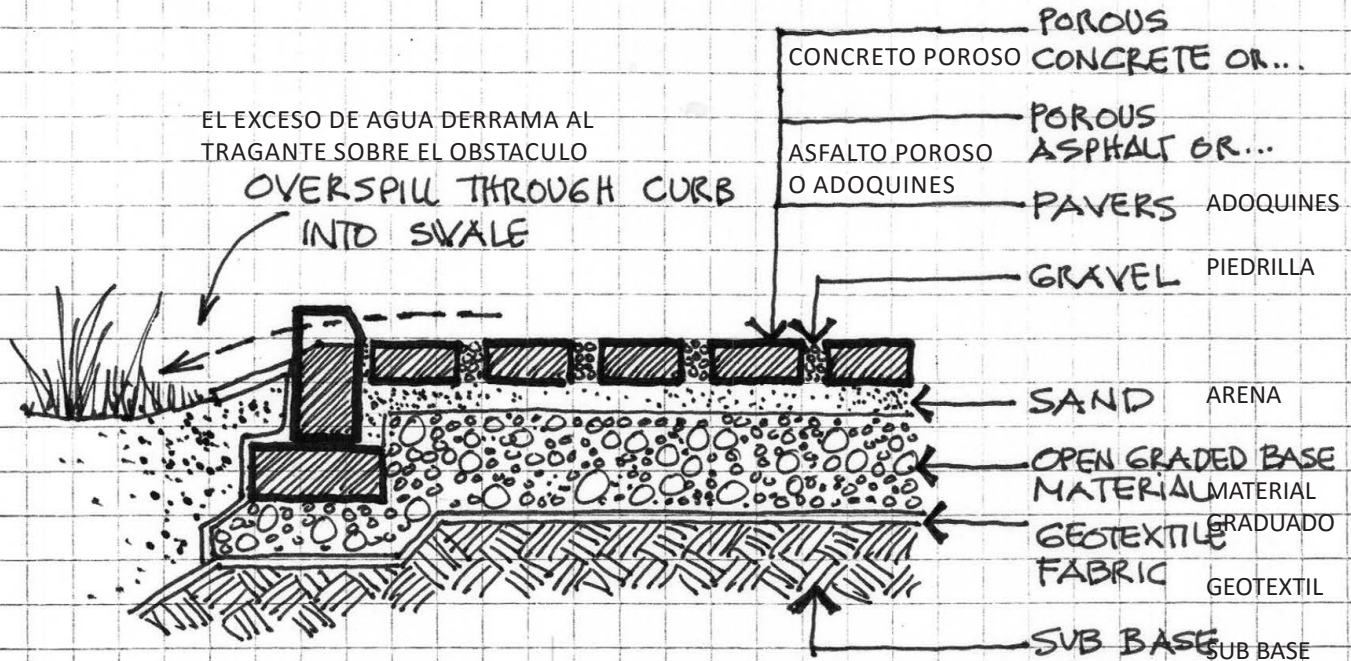
3/30

NOTES

- 12" DEPTH MINIMUM TO PREVENT "WEEDS" GROWTH
- 12" MÍNIMAS DE PROFUNDIDAD PARA PREVENIR EL CRECIMIENTO DE HIERBAS

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GREEN CONSTRUCTION DETAILS



DETALLE PAVIMENTO PERMEABLE

PERMEABLE PAVING DETAIL

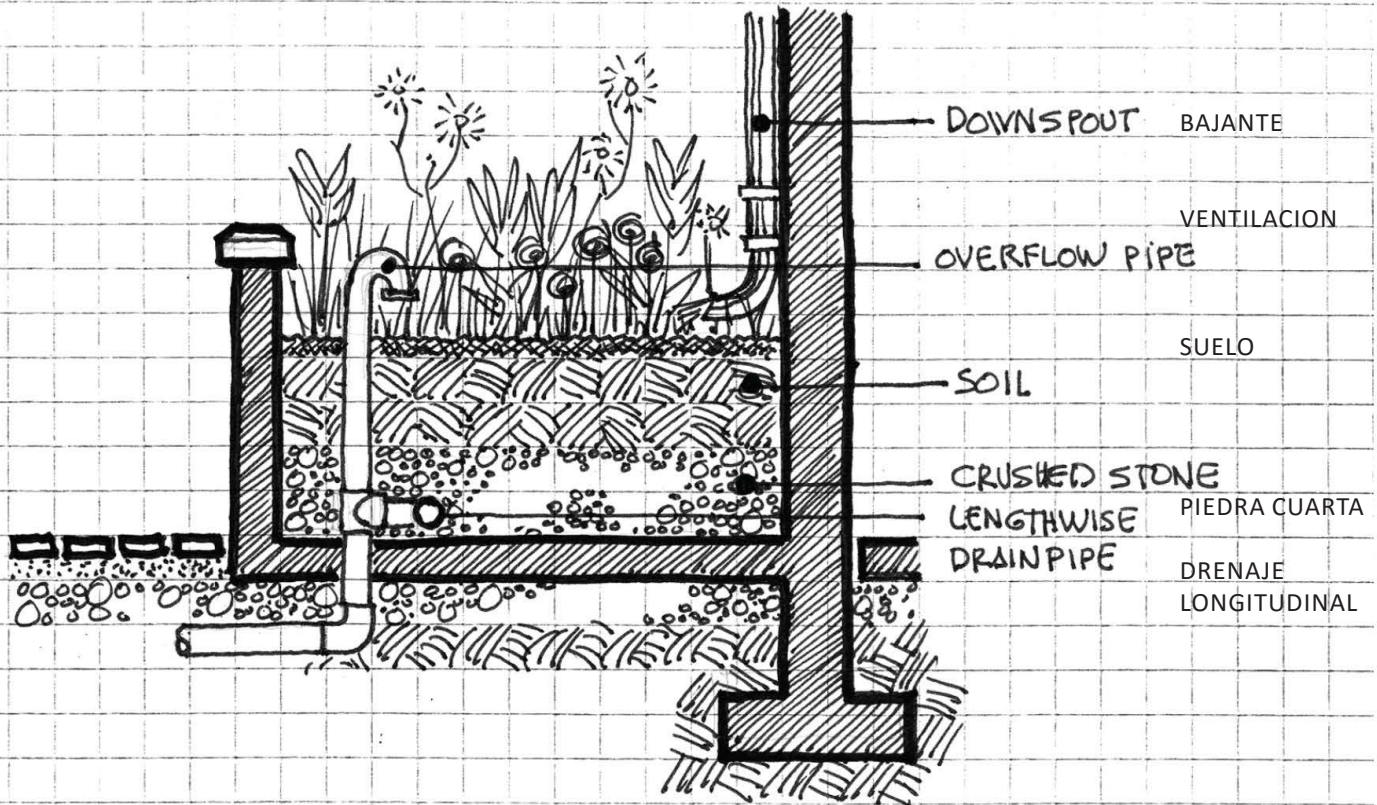
4/30

NOTES

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GREEN CONSTRUCTION DETAILS

U



DETALLE DE FLUJO EN LA JARDINERA

Las jardineras de flujo crean un contenedor sellado que libera gradualmente el agua a través de la evapo-transpiración o cualquier otro elemento en caso de borrasca a través del tubo de drenaje longitudinal

5/30

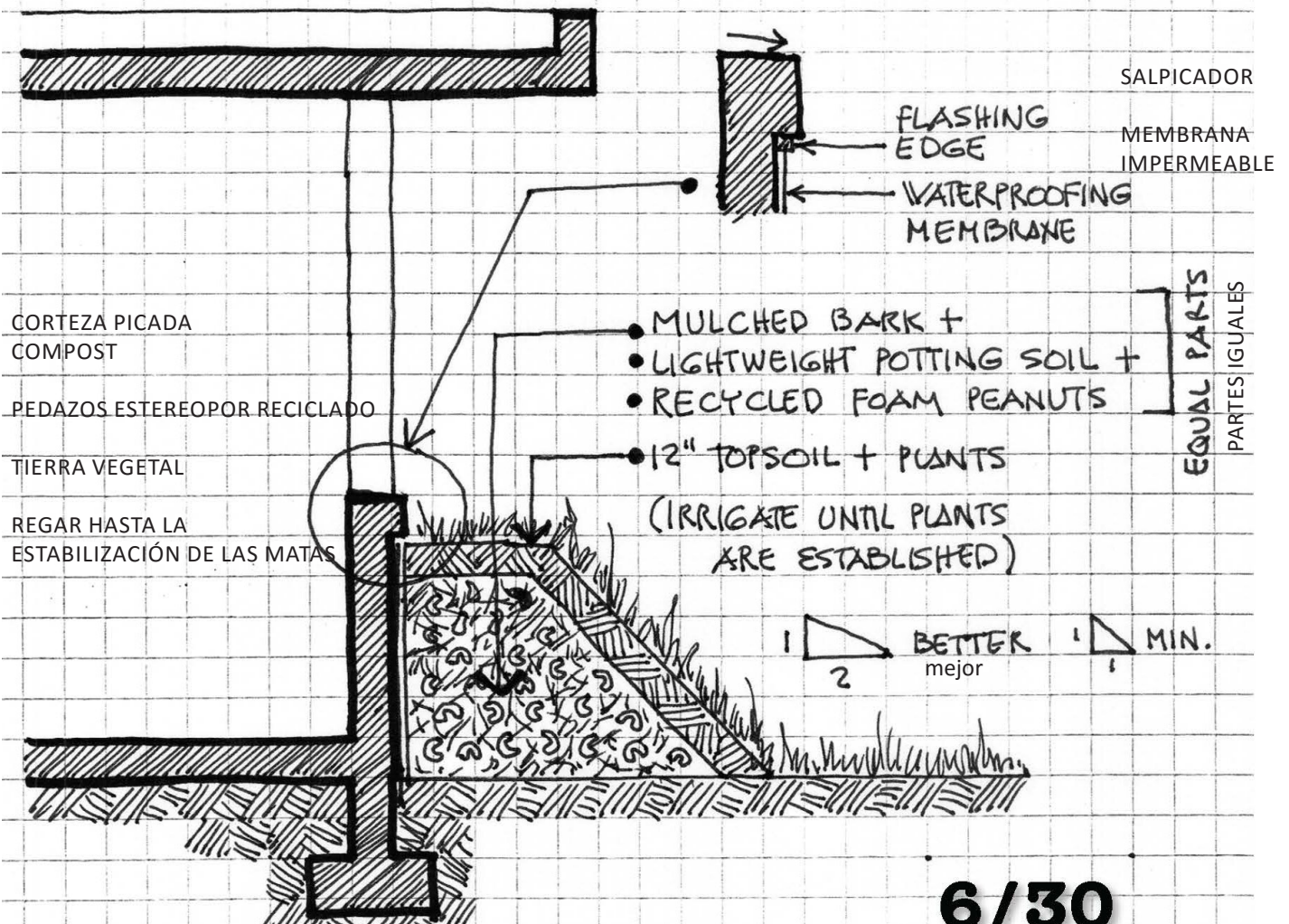
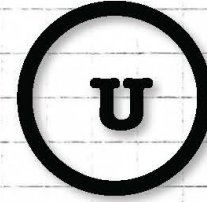
FLOW-THROUGH PLANTER DETAIL

NOTES

- A FLOW-THROUGH PLANTER CREATES A SEALED CONTAINER THAT GRADUALLY RELEASES THE WATER THROUGH EVAPOTRANSPIRATION OR TO OTHER STORMWATER FEATURES BY MEANS OF OVERFLOW PIPE OR LENGTHWISE DRAIN PIPE.

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GREEN CONSTRUCTION DETAILS



INSULATIVE BERM DETAIL

6/30

NOTES

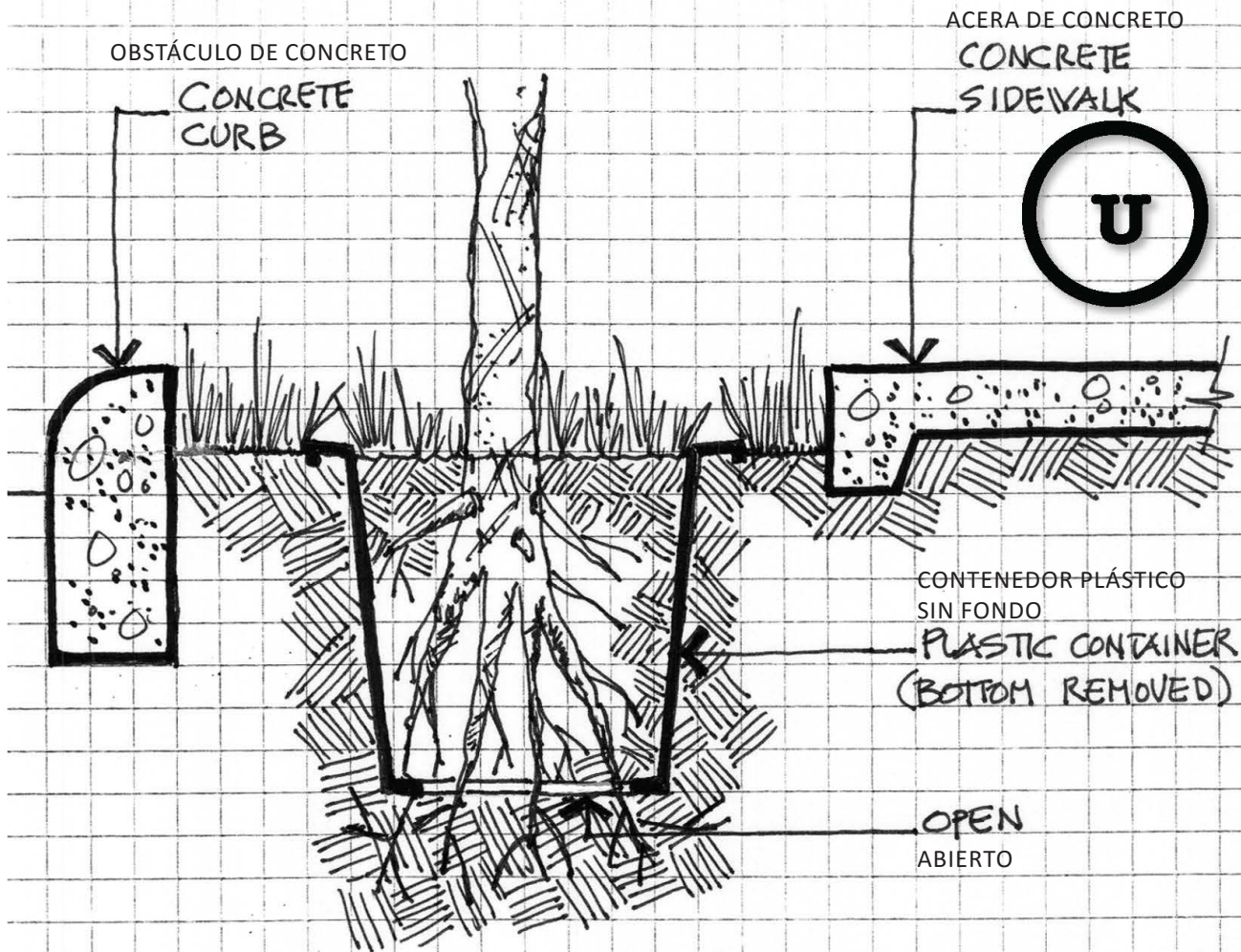
- IRRIGATE UNTIL ROOT SYSTEM IS STABILIZED.

AISLAMIENTO DE TALUDES

REGAR HASTA QUE EL SISTEMA RADICULAR SE HA ESTABILIZADO

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GREEN CONSTRUCTION DETAILS



DETALLE DE CONTROL DE RAÍCES INVASIVAS

INVASIVE ROOT CONTROL DETAIL

7/30

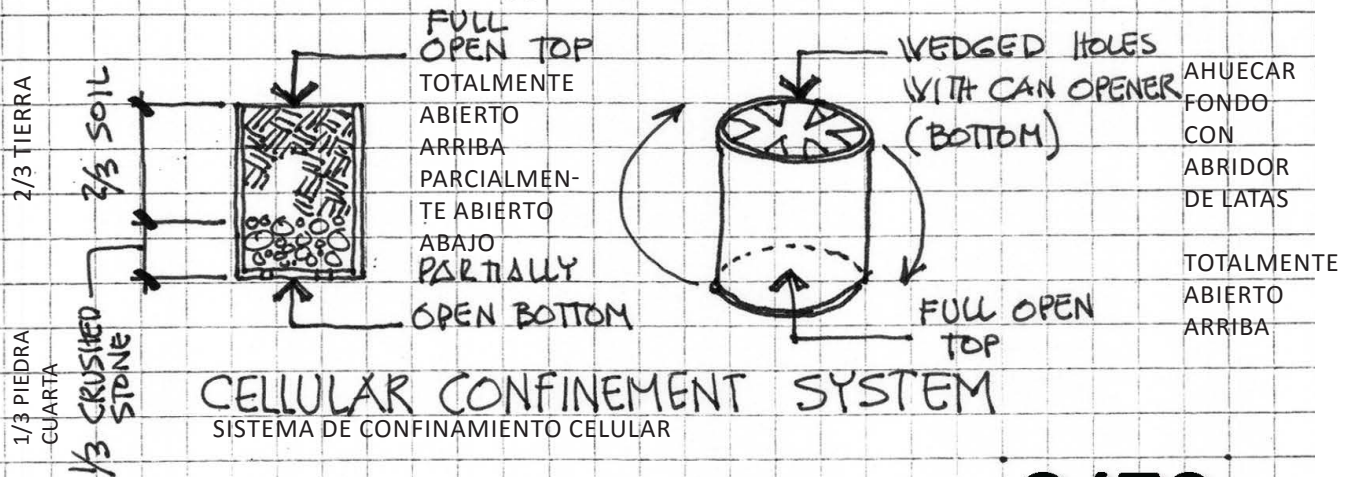
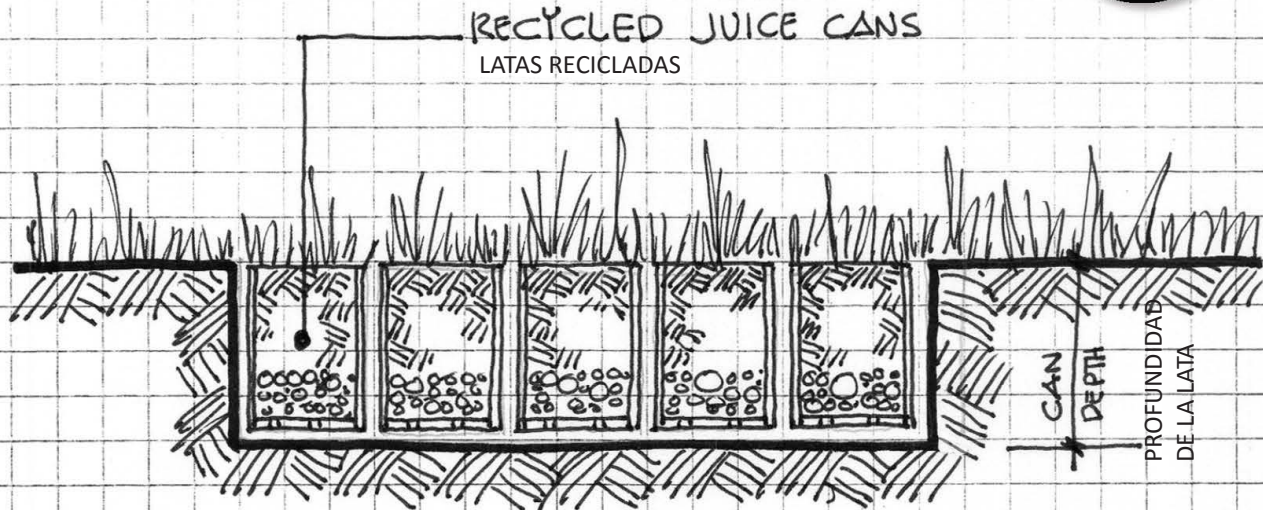
NOTES

- DEEPER CONTAINERS WORK BEST.
LOS CONTENEDORES PROFUNDOS FUNCIONAN MEJOR

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GREEN CONSTRUCTION DETAILS

D



8/30

PERMEABLE NATURAL PAVEMENT

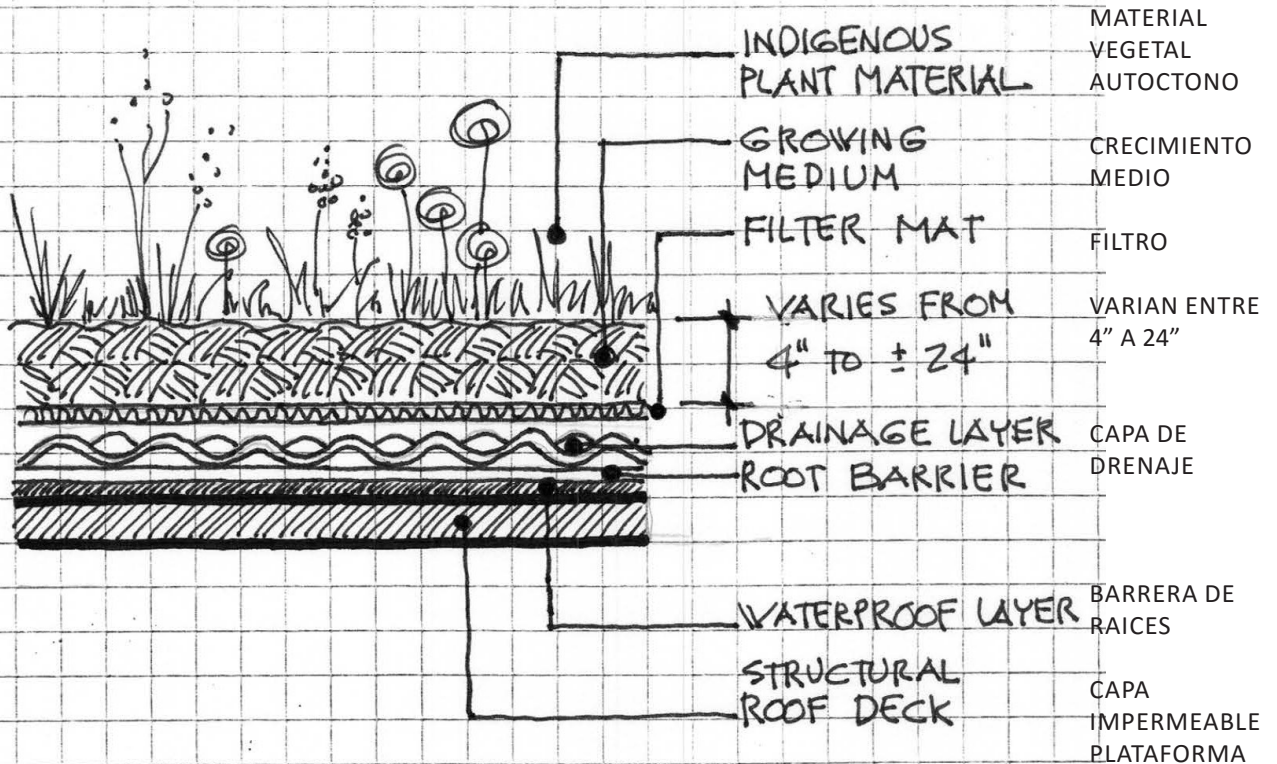
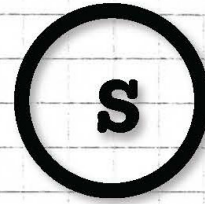
PAVIMENTO PERMEABLE NATURAL

NOTES

- RECYCLED JUICE CANS ACT AS STRUCTURAL SUBSTRATE FOR TEMPORARY PARKING AREAS
- DEEPER CANS ARE PREFERRED
- NATURAL OXIDATION BRING CANS BACK TO THE SOIL

LAS LATAS RECICLADAS ACTUAN COMO SUSTRATO ESTRUCTURAL PARA ESTACIONAMIENTOS TEMPORALES
PREFERIR LATAS PROFUNDAS

GREEN CONSTRUCTION DETAILS



9/30

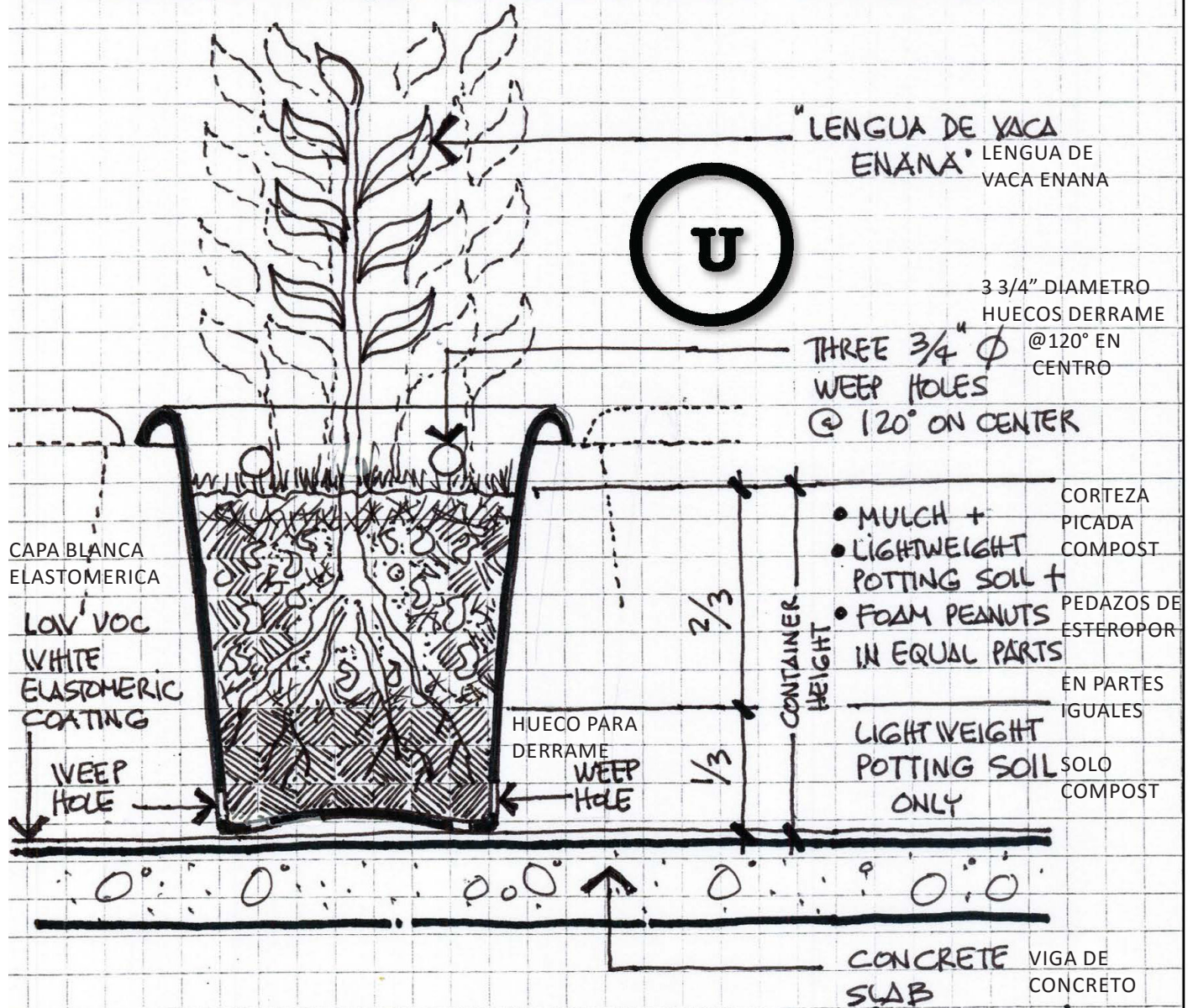
TYPICAL GREEN ROOF ELEMENTS

NOTES

ELEMENTOS DE TECHO VERDE

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GREEN CONSTRUCTION DETAILS



10/30

CONTAINER GREEN ROOF DETAIL

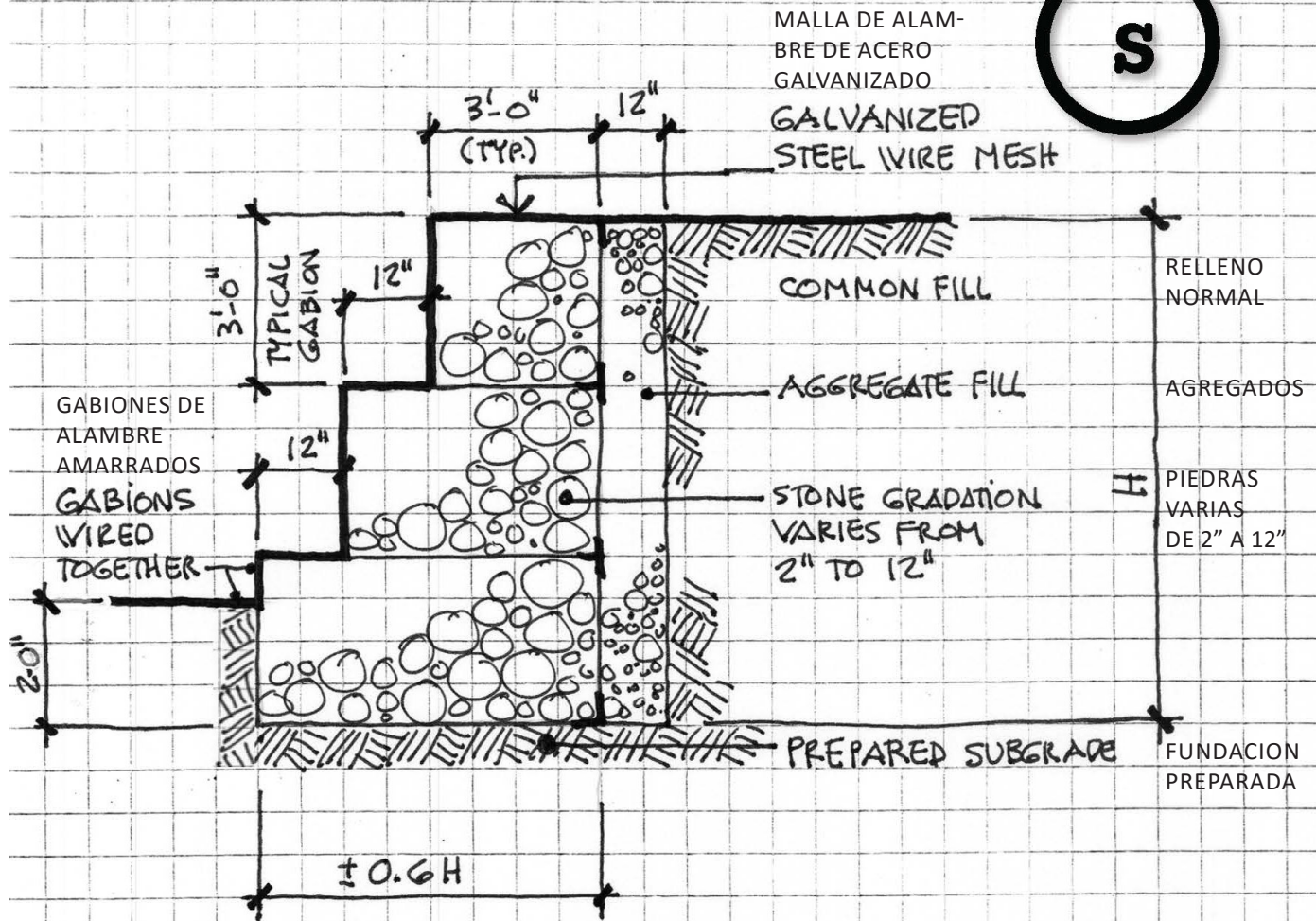
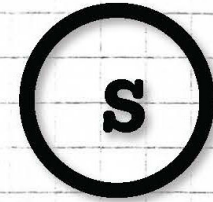
DETALLE DEL CONTENEDOR DE TECHO VERDE

NOTES

- CONSULT A STRUCTURAL ENGINEER BEFORE LOADING ROOF.
- MAINTAIN LESS THAN 9" GROWTH MEDIUM TO REDUCE DEAD LOAD.

CONSULTE A UN INGENIERO ESTRUCTURAL ANTES DE CARGAR EL TECHO
MANTENGA MENOS DE 9" DE PROMEDIO DE CRECIMIENTO PARA REDUCIR LA CARGA MUERTA

GREEN CONSTRUCTION DETAILS



MURO DE CONTENCIÓN EN GABIONES

11/30

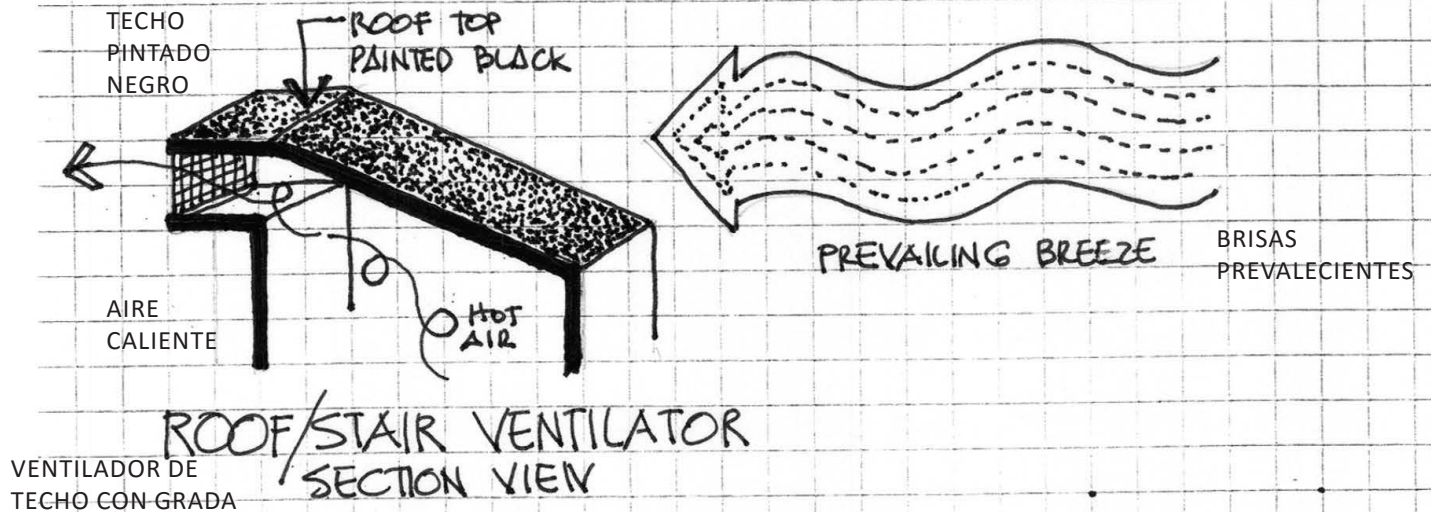
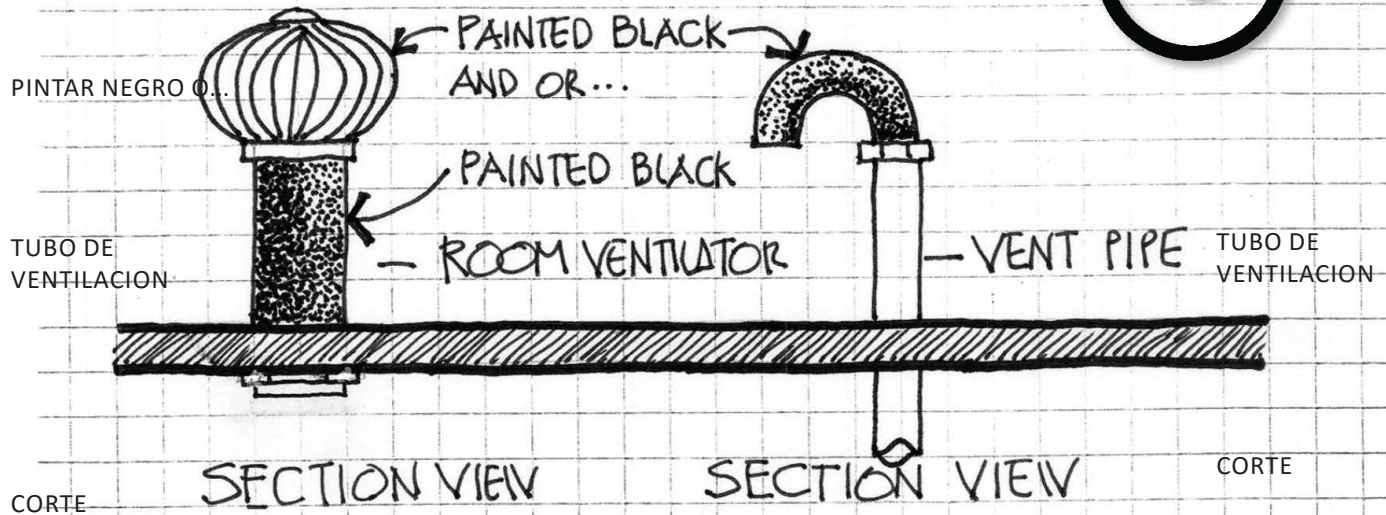
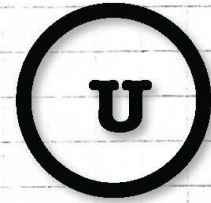
STONE GABION RETAINING WALL

NOTES

- TYPICALLY USED IN PUBLIC PARK, HIGHWAY AND COMMERCIAL SETTINGS TÍPICAMENTE USADOS EN PARQUES PÚBLICOS, AUTOPISTAS, Y ÁREAS COMERCIALES
- IN HEAVY CLAYS OR WET SOILS, A BASE TO HEIGHT RATIO OF 0.6H TO 0.75H IS RECOMMENDED.

EN SUELOS ARCILLOSOS O HUMEDOS SE RECOMIENDA UNA BASE PROMEDIO DE 0.6 h a 0.75 h.

GREEN CONSTRUCTION DETAILS



NATURAL VENTILATORS DETAIL:

DETALLE DE VENTILADORES NATURALES

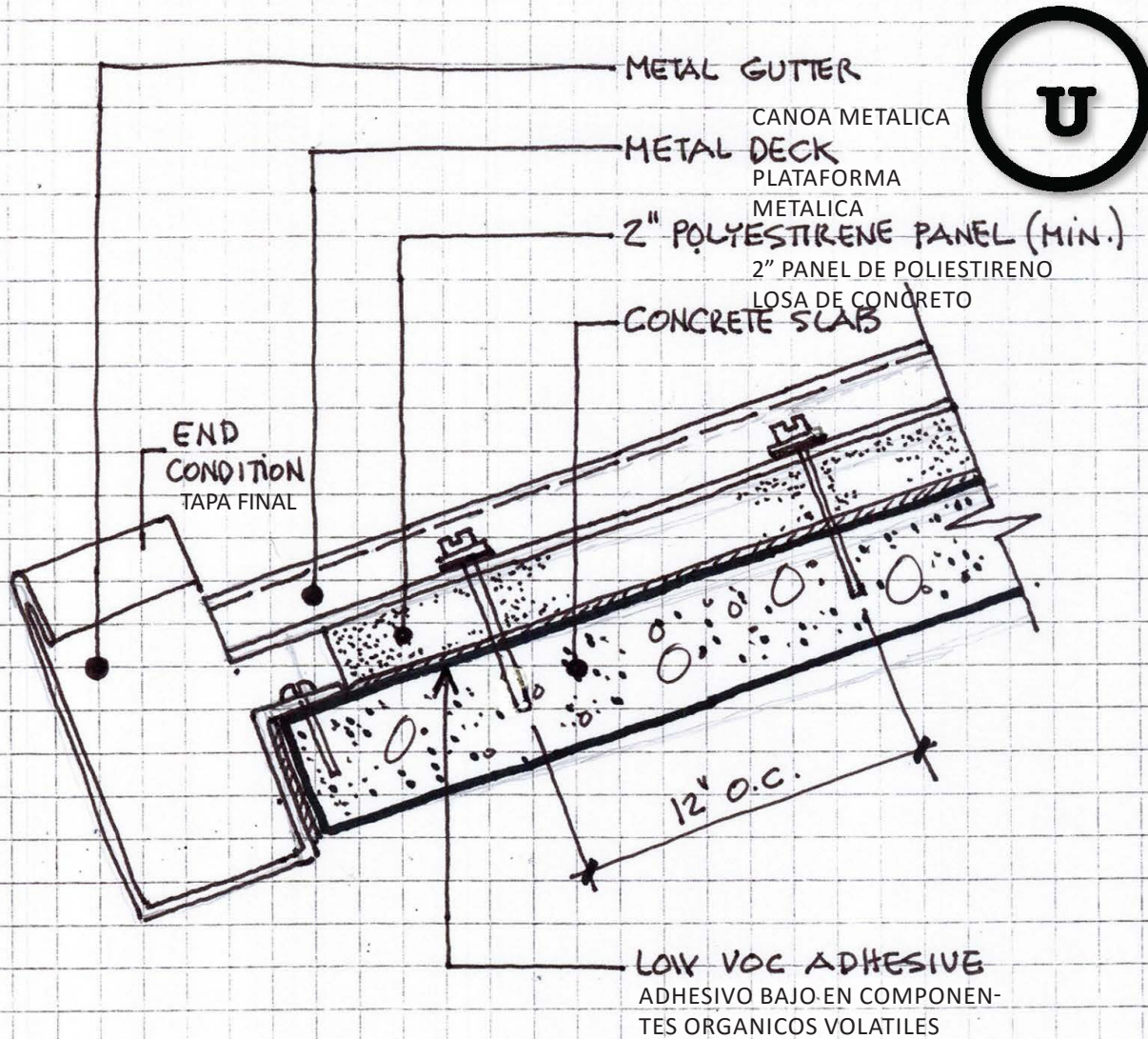
12/30

NOTES

- TO PREVENT HOT AIR BACK FLOW, MAKE SURE ROOF/STAIR VENTILATOR ARE PROPERLY ORIENTED

PARA PREVENIR QUE EL FLUJO DE AIRE CALIENTE SE DEVUELVA, ASEGURESE QUE EL VENTILADOR ESTE CORRECTAMENTE ORIENTADO

GREEN CONSTRUCTION DETAILS



INSULATED CONCRETE SLAB DETAIL

DETALLE DE VIGA DE CONCRETO AISLADA

13/30

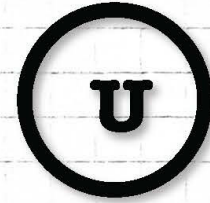
NOTES

- INSULATION THICKNESS: NO LESS THAN 2"
- METAL WASHER OVER RUBBER WASHER TO MITIGATE ULTRA VIOLET OXIDATION.

GROSOR AISLAMIENTO NO MENOR A 2"

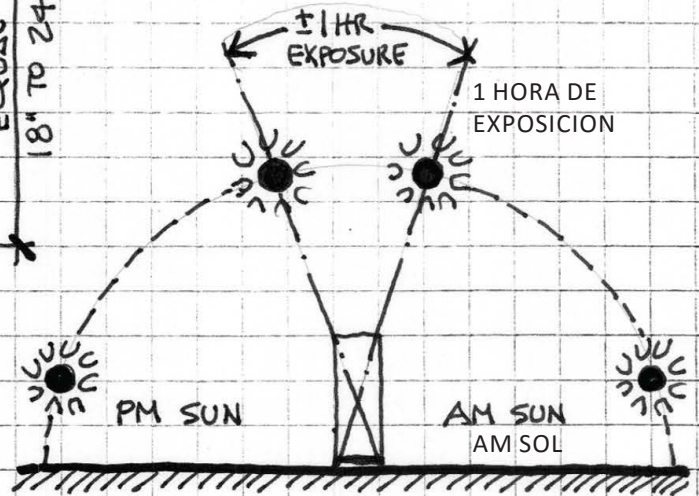
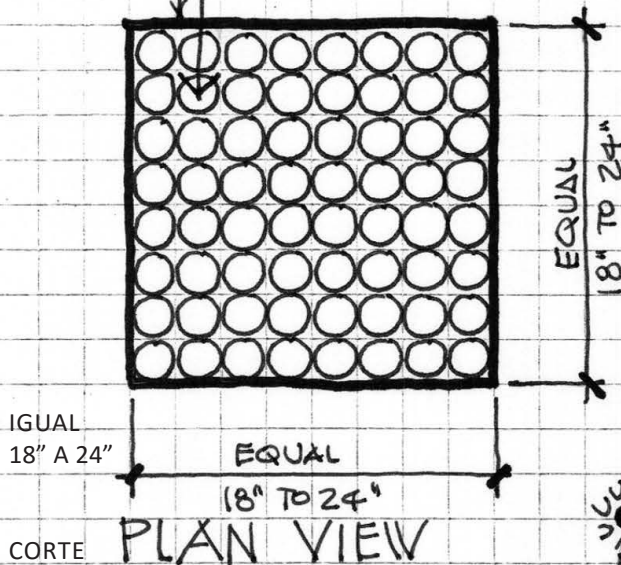
CANOA METALICA SOBRE CANOA DE HULE PARA MITIGAR LA OXIDACION POR RAYOS ULTRAVIOLETA

GREEN CONSTRUCTION DETAILS



MARCO CON LATAS
RECICLADAS

FRAME
RECYCLED CANS



AGUA DE LLUVIA
3/4" ESPACIO

RAIN WATER
± 3/4" SPACE

RECYCLED CANS
(TOP & BOTTOM REMOVED)

LATAS RECICLADAS TAPAS INFERIOR Y
SUPERIOR REMOVIDAS

FRAME MARCO

ELEVACION

SECTION VIEW

SHADOW COLLECTOR DETAIL

DETALLE DE COLECTORES DE SOMBRA

14/30

NOTES

- TALLER CANS ARE BETTER
- FRAME: METAL, PLASTIC BELT, WOOD FRAME, OTHERS
- 3/4" SPACE REQUIRED FOR RAIN WATER REMOVAL AT BASE.

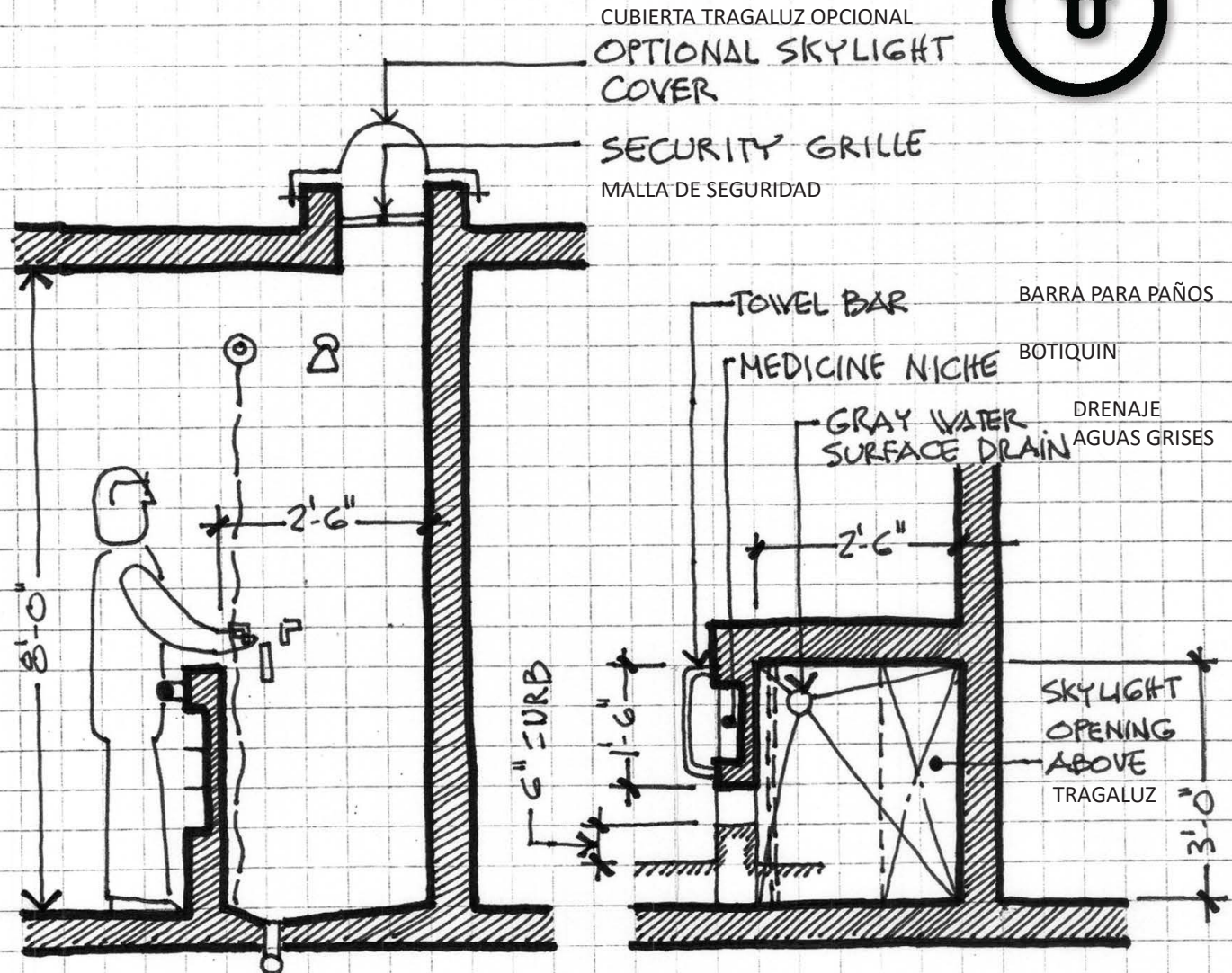
LATAS ALTAS SON MEJORES

MARCO: METAL, FAJA PLASTICA, MARCO MADERA, OTROS

3/4 ESPACIO REQUERIDO PARA REMOVER AGUA DE LLUVIA EN LA BASE

GREEN CONSTRUCTION DETAILS

U



SECTION VIEW

ELEVACION

PLAN VIEW

PLANTA

15/30

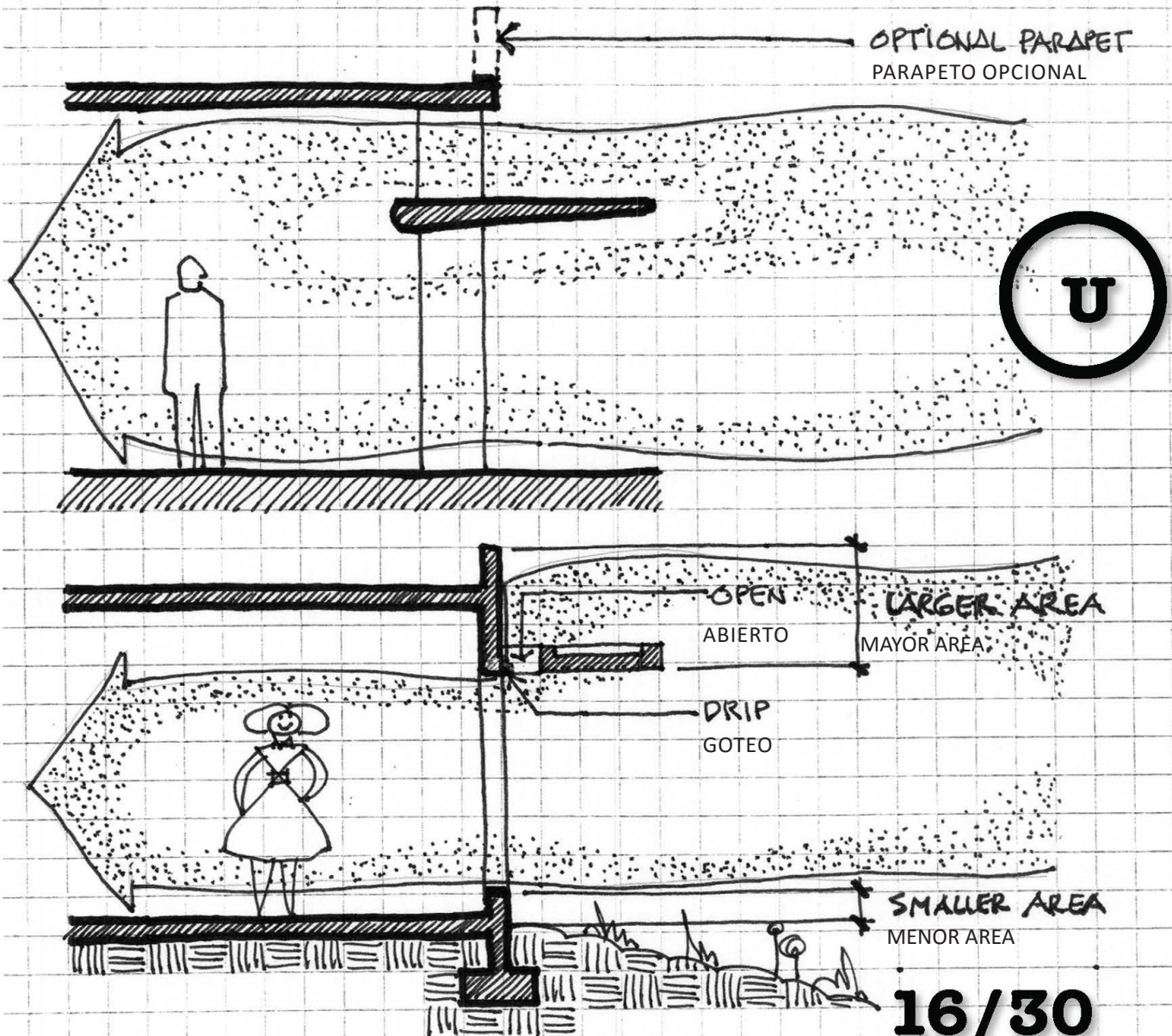
HYBRID LAVATORY/SHOWER DETAIL

LAVATORIO HIBRIDO/ DETALLE DE DUCHA

NOTES

- USE ONLY "NO PHOSPHATE" DETERGENTS FOR GRAY WATER SYSTEM. USAR SOLO DETERGENTES NO FOSFATADOS PARA EL SISTEMA DE AGUAS GRISES
- DRAIN DIRECT TO OUTDOOR VEGETATED AREA. DRENAJE DIRECTO AL AREA VEGETAL EXTERNA
- PREVENT SURFACE PONDING. PREVENIR CHARCOS

GREEN CONSTRUCTION DETAILS



PRESSURE NEUTRAL OVERHANG DETAIL

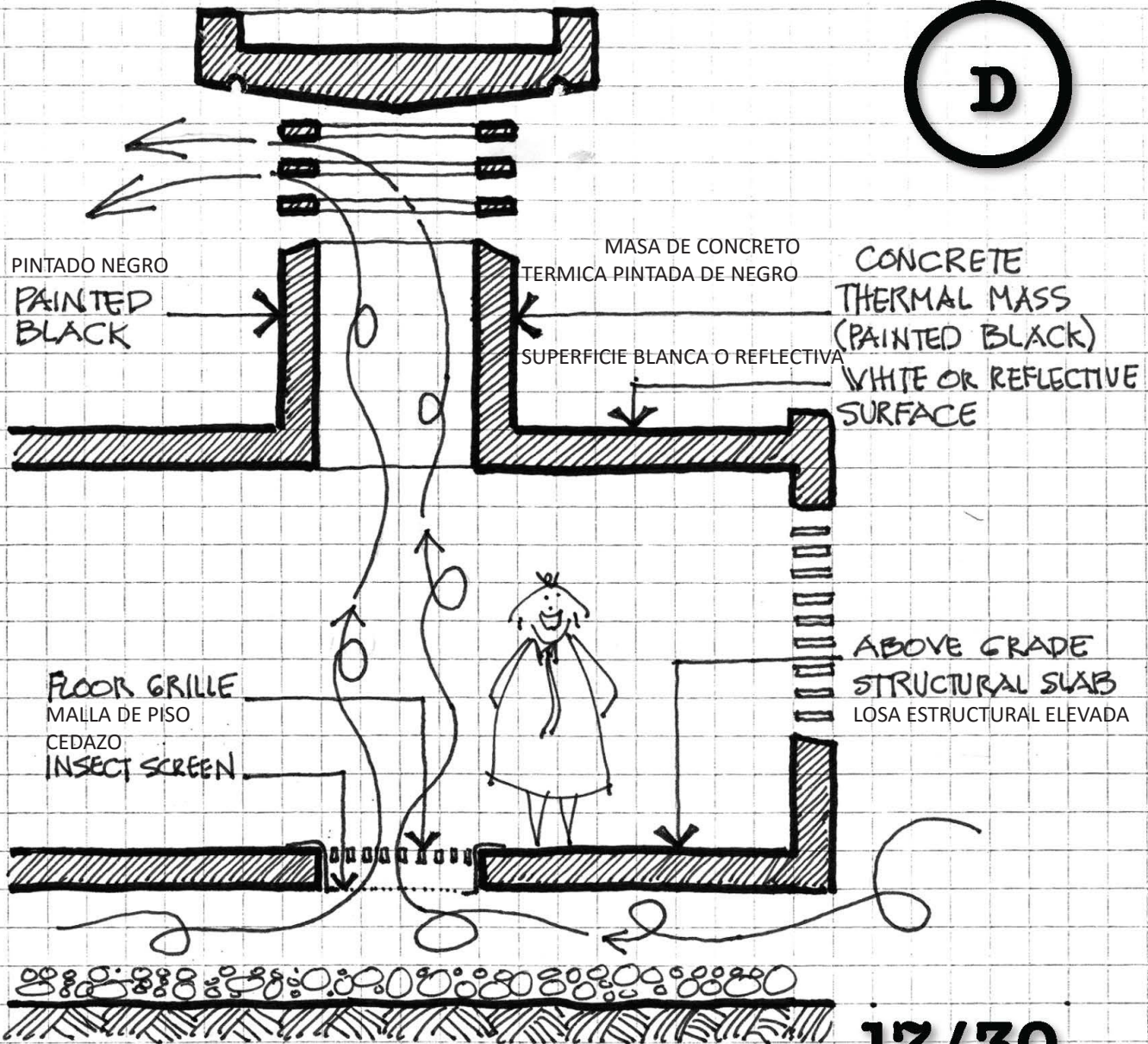
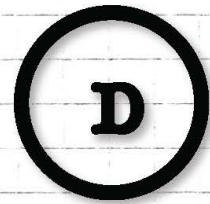
DETALLE DE LA PRESION NEUTRAL DE LOS ALEROS

16/30

NOTES

- PRESSURE NEUTRAL OVERHANGS WILL NOT ADVERSELY AFFECT INTERIOR WIND PATTERNS (FLOWS) LA PRESION NEUTRAL DE LOS ALEROS NO AFECTA NEGATIVAMENTE A LOS PATRONES DE VIENTO INTERNO
- MAKE SURE UPPER PARAPET IS BIGGER IN AREA THAN LOWER PARAPET OR CORB ON ONE STORY BUILDINGS. ASEGURESE QUE EL AREA DEL PARAPETO SUPERIOR ES MAS GRANDE QUE LA DEL INFERIOR EN EDIFICIOS DE UN PISO

GREEN CONSTRUCTION DETAILS



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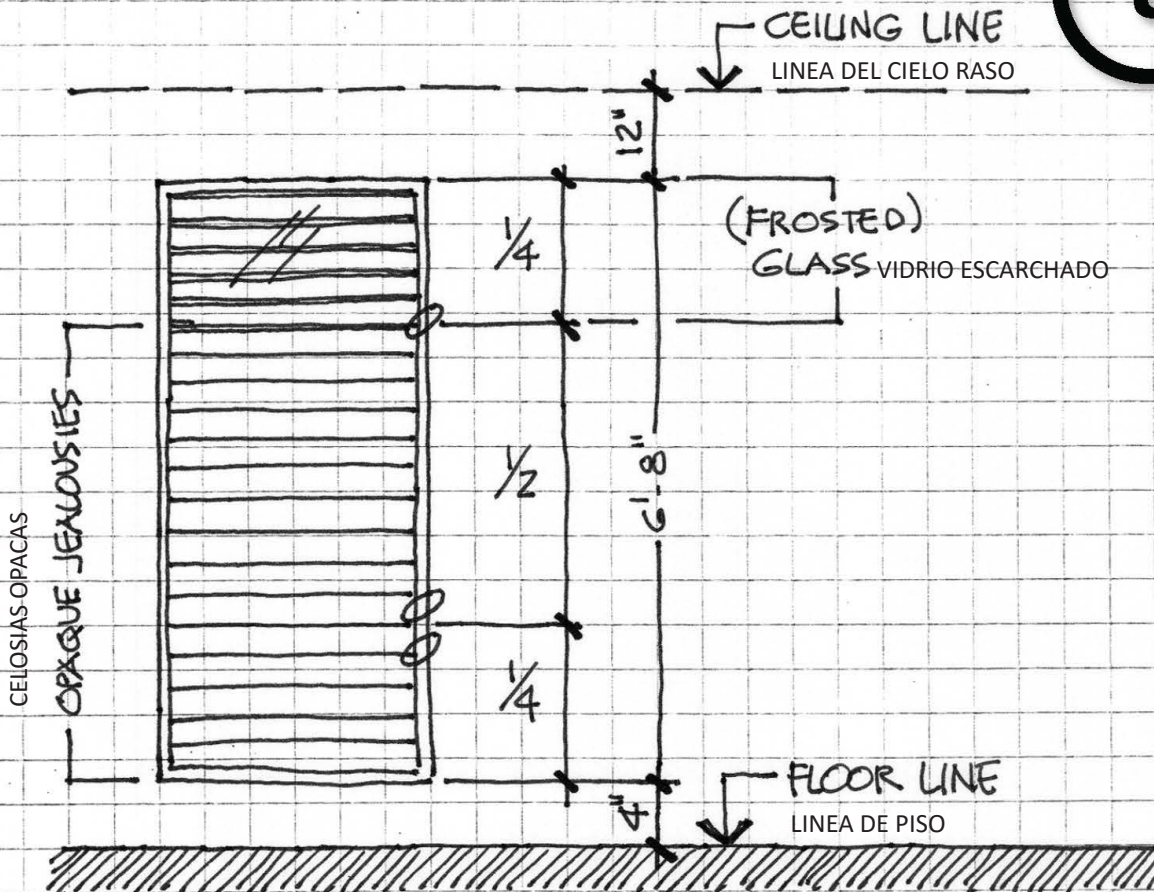
AFTER 9:00 PM VENT DETAIL

DETALLE DE VENTILACION DESPUES DE LAS 9PM

NOTES

GREEN CONSTRUCTION DETAILS

U



VENTILATING CLERESTORY WINDOW

VENTANA VENTILADOR CLERESTORIO

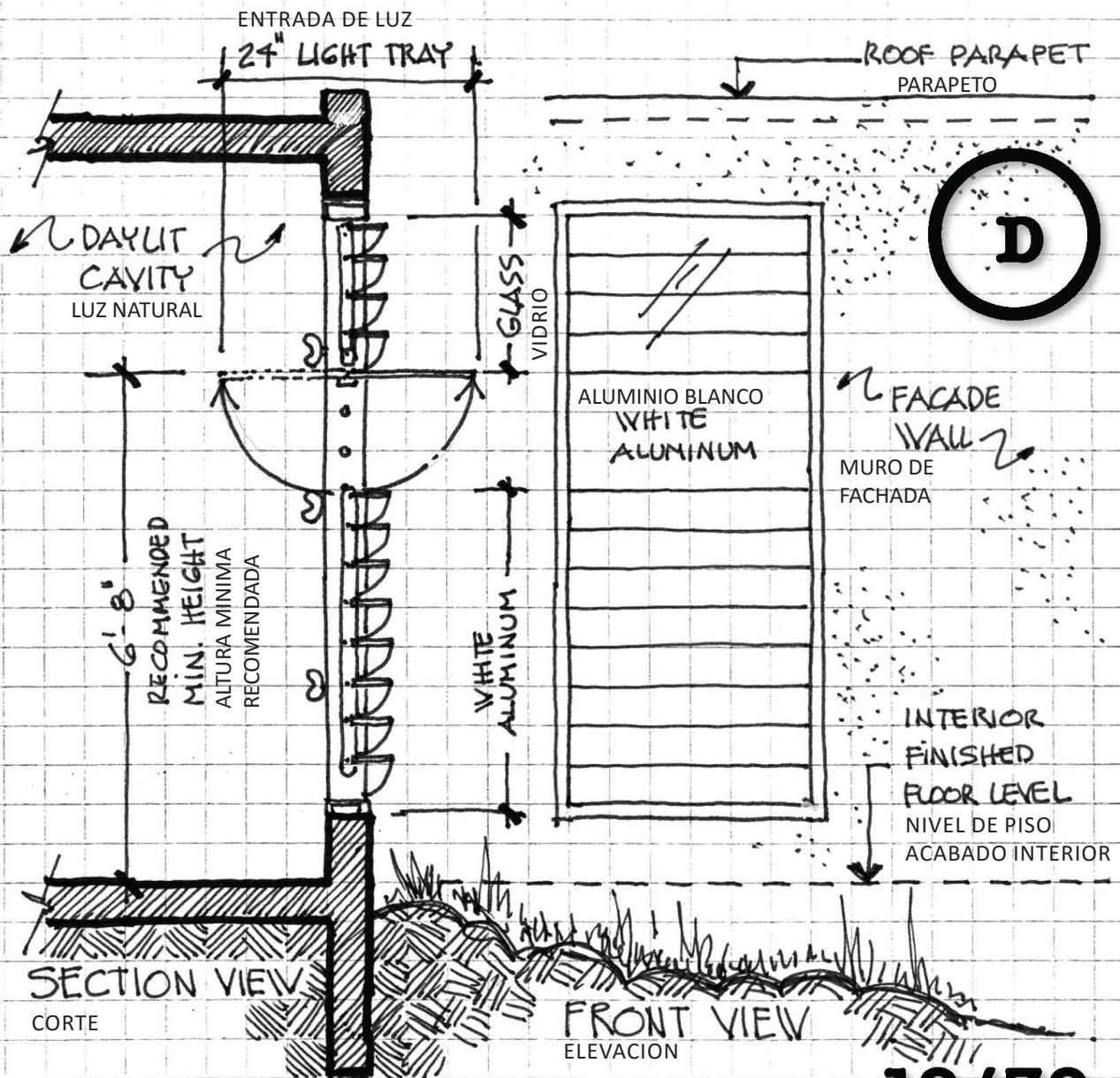
18/30

NOTES

- FROSTED GLASS JEALOUSIES PROMOTE NATURAL VENTILATION & DAY LIGHTING LAS CELOSÍAS DE VIDRIO ESCARCHADO PERMITEN VENTILACIÓN Y LUZ NATURAL
- BEST ORIENTATIONS: NORTH & SOUTH FACADES

LA MEJOR ORIENTACION: FACHADAS NORTE Y SUR

GREEN CONSTRUCTION DETAILS



WINDOW LIGHT TRAY DETAIL

DETALLE DE LA ENTRADA DE LUZ

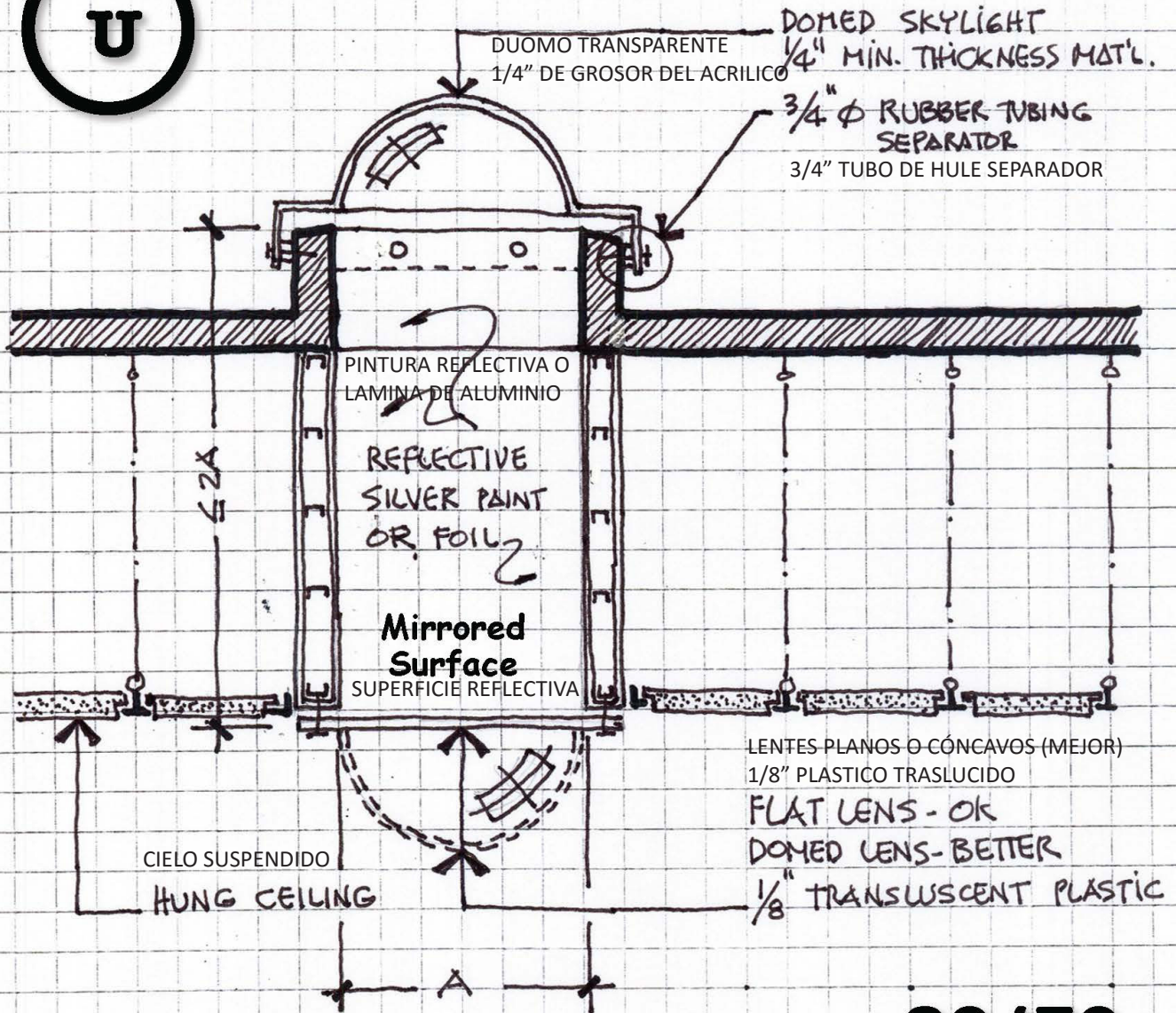
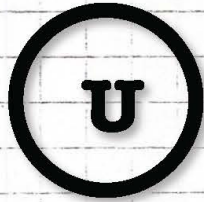
19/30

NOTES

- MAINTAIN 6'-8" (TYPICAL DOOR) HEIGHT FROM FINISHED FLOOR TO LOWER SURFACE OF LIGHT TRAY FOR SAFETY PURPOSES.

MANTENGA LA ALTURA 6'8" (PUERTA TÍPICA) DEL NIVEL DE PISO ACABADO HASTA LA SUPERFICIE INFERIOR DE LA BANDEJA DE ILUMINACIÓN, POR SEGURIDAD

GREEN CONSTRUCTION DETAILS



DETALLE LUCERNARIO

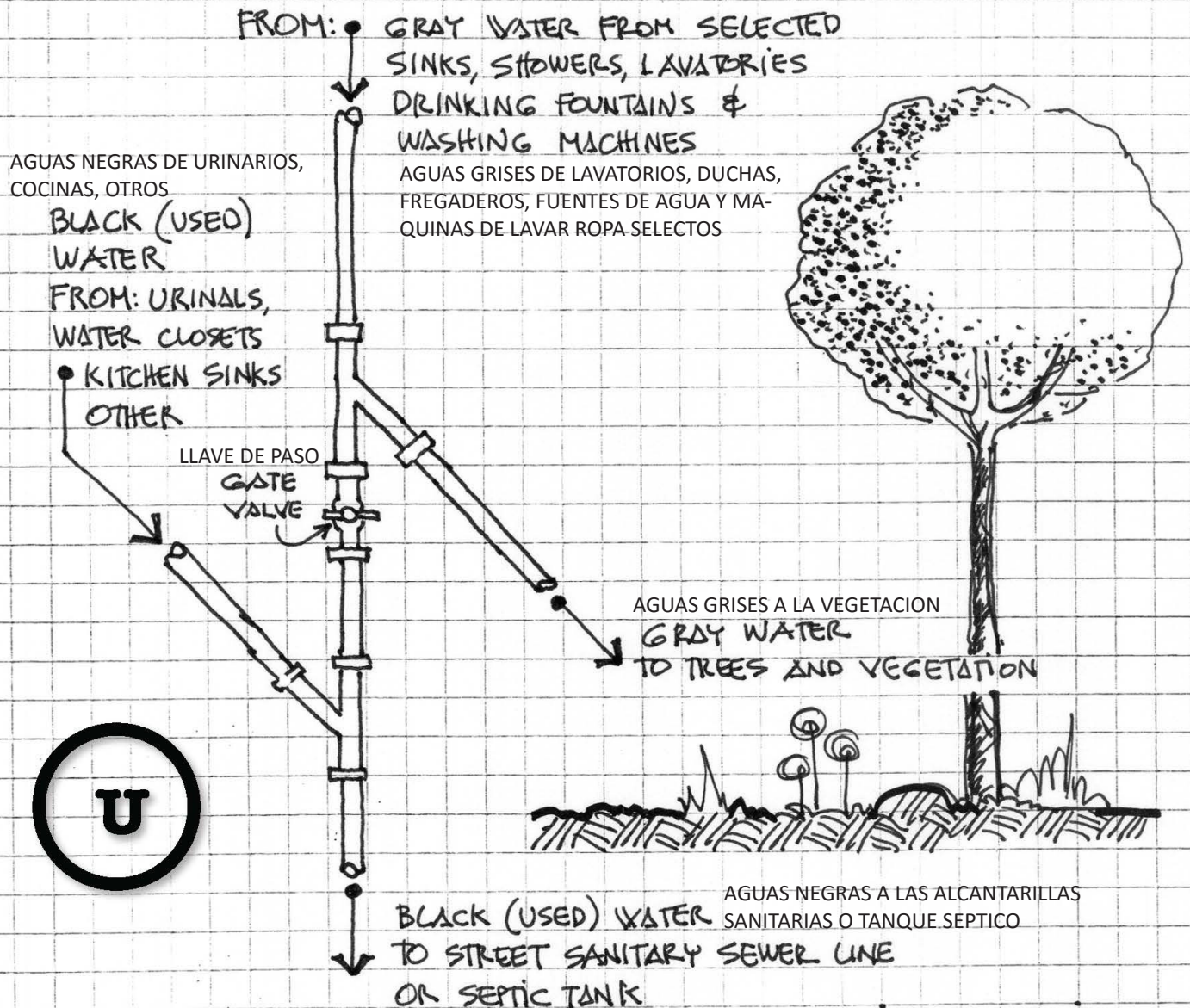
LIGHT CHIMNEY DETAIL

20/30

NOTES

- 3/4" ϕ RUBBER TUBING SEPARATOR FOR HOT AIR REMOVAL
3/4" DIAMETRO DEL TUBO DE HULE SEPARADOR PARA REMOVER EL AIRE CALIENTE

GREEN CONSTRUCTION DETAILS



GRAY WATER DIVERTING VALVE

VALVULA DE DESVIACION DE LAS AGUAS GRISES

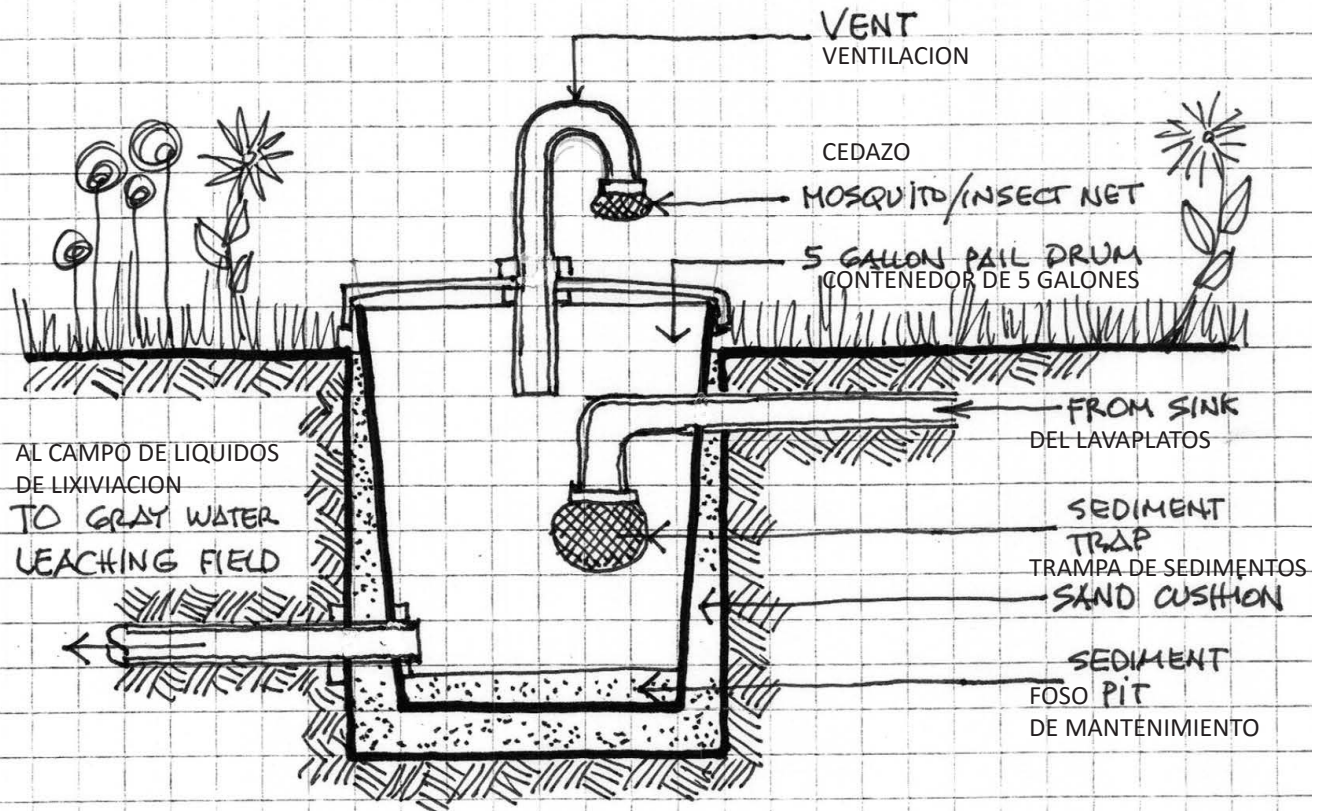
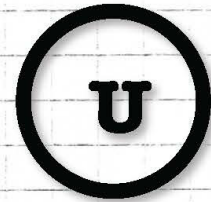
21/30

NOTES

- DIVERTING VALVE IS USED DEPENDING ON SPECIFIC USE OF SELECTED PLUMBING FIXTURES.

LA VALVULA DE DESVIACION SE USA DEPENDIENDO DEL USO ESPECIFICO DE LAS GRIFERIAS SELECTAS

GREEN CONSTRUCTION DETAILS



22/30

GRAY WATER FILTERING TANK DETAIL

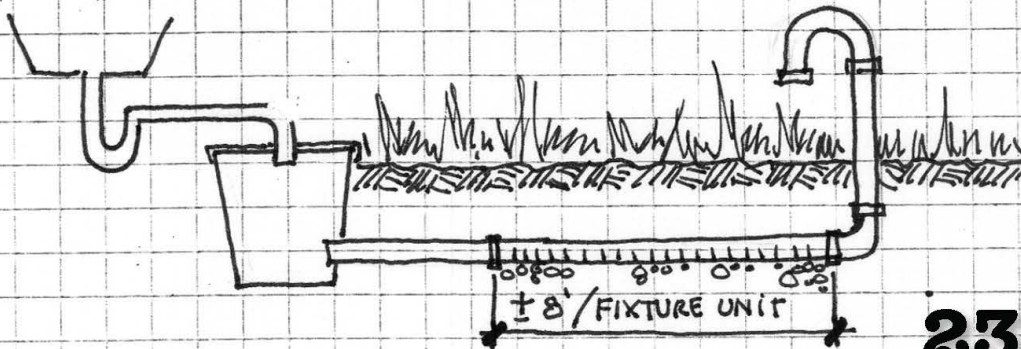
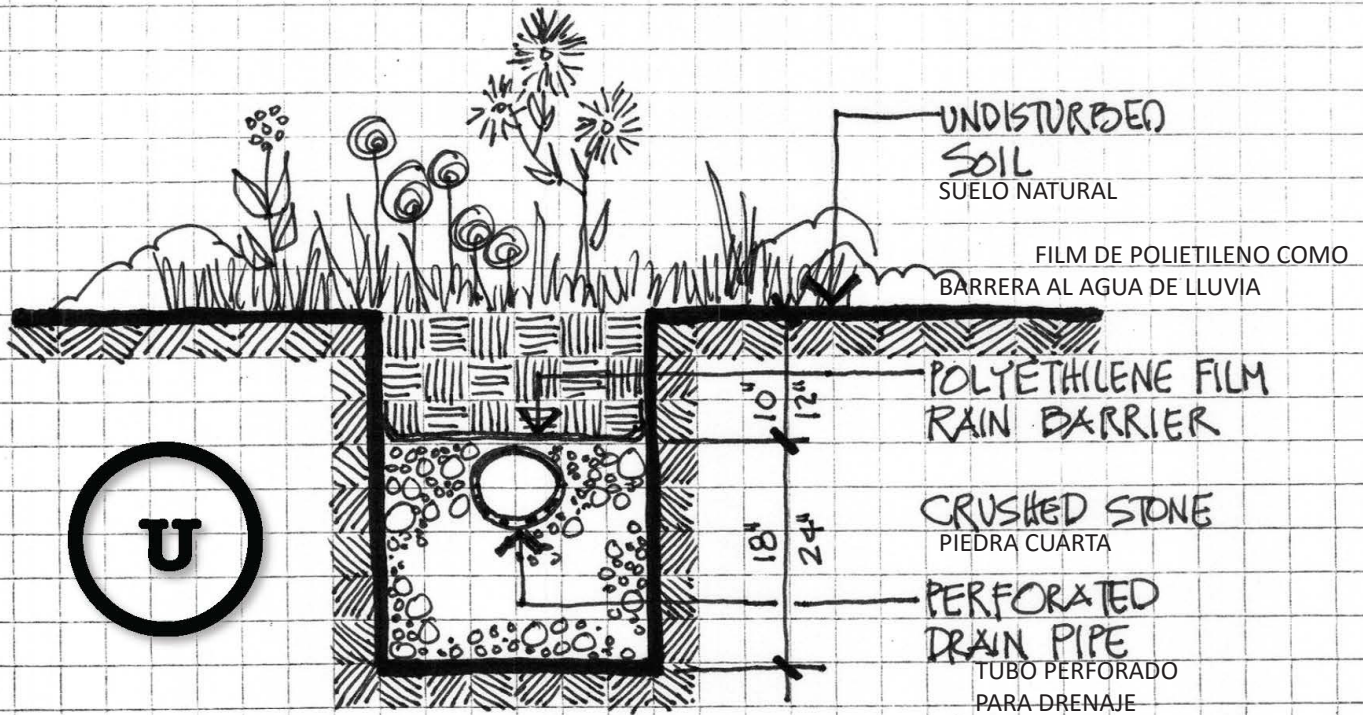
DETALLE DEL TANQUE QUE FILTRA LAS AGUAS GRISES

NOTES

- PERIODICAMENTE LIMPIAR LA TRAMPA DE SEDIMENTOS Y EL FOSO DE MANTENIMIENTO
- PERIODICALLY CLEAN SEDIMENT TRAP & PIT.
- SHADED AREA WILL REDUCE ULTRAVIOLET RADIATION EFFECT ON PAIL COVER AND VENT PIPE
- AREAS SOMBRIAS REDUCIRAN LOS EFECTOS DE LA RADIACION ULTRAVIOLETA EN LA TAPA COBERTORA Y EL TUBO DE VENTILACION

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GREEN CONSTRUCTION DETAILS



GRAY WATER TRENCH DETAIL

DETALLE DE TRINCHERA PARA AGUAS GRISES

23/30

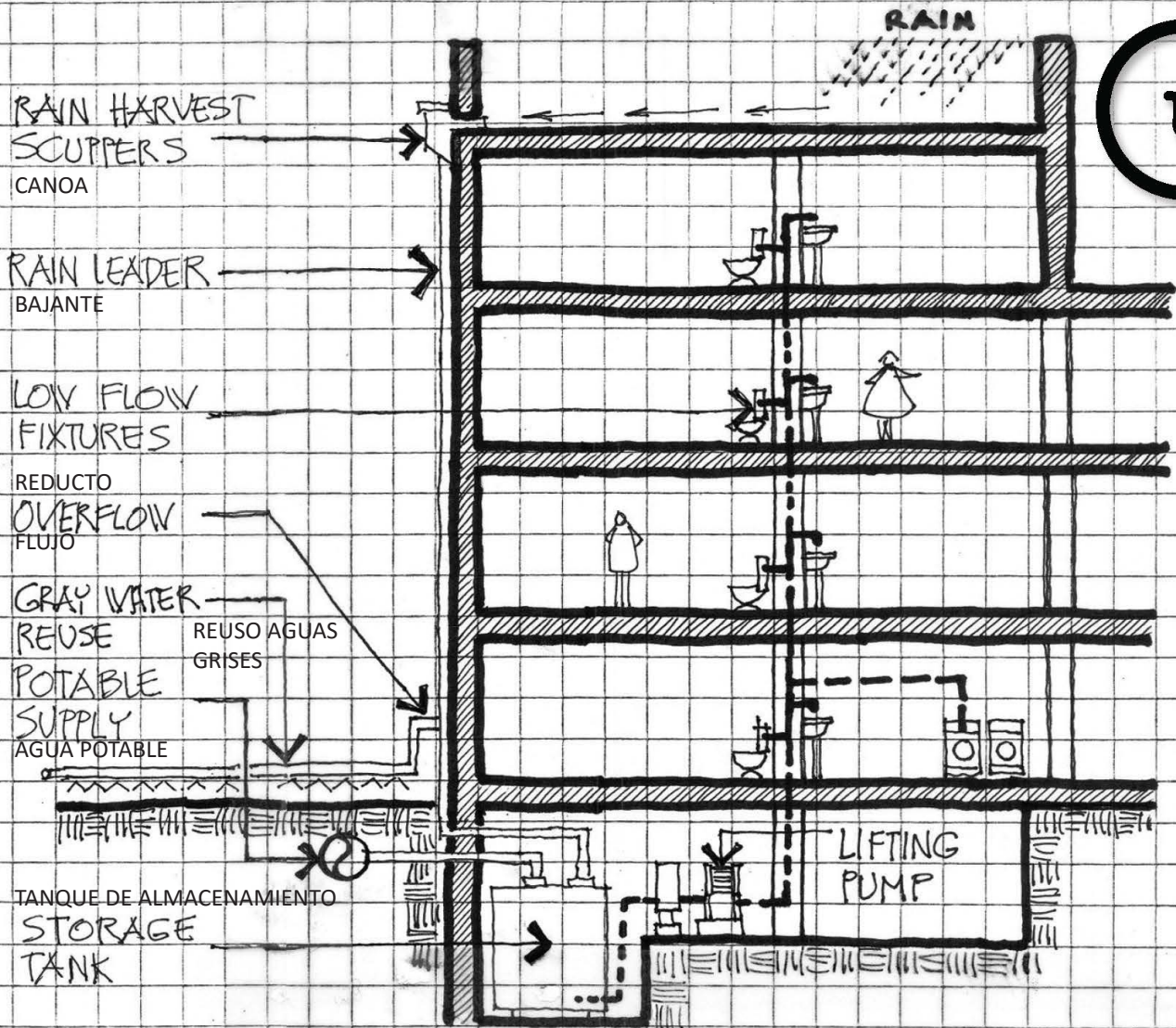
NOTES

- RAIN BARRIER PREVENTS RAIN WATER SATURATION OF TRENCH.

LA BARRERA DEL AGUA DE LLUVIA PERMITE PREVENIR LA SATURACION DE LA TRINCHERA

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GREEN CONSTRUCTION DETAILS



SISTEMA DE RECOLECCIOND EAGUAS

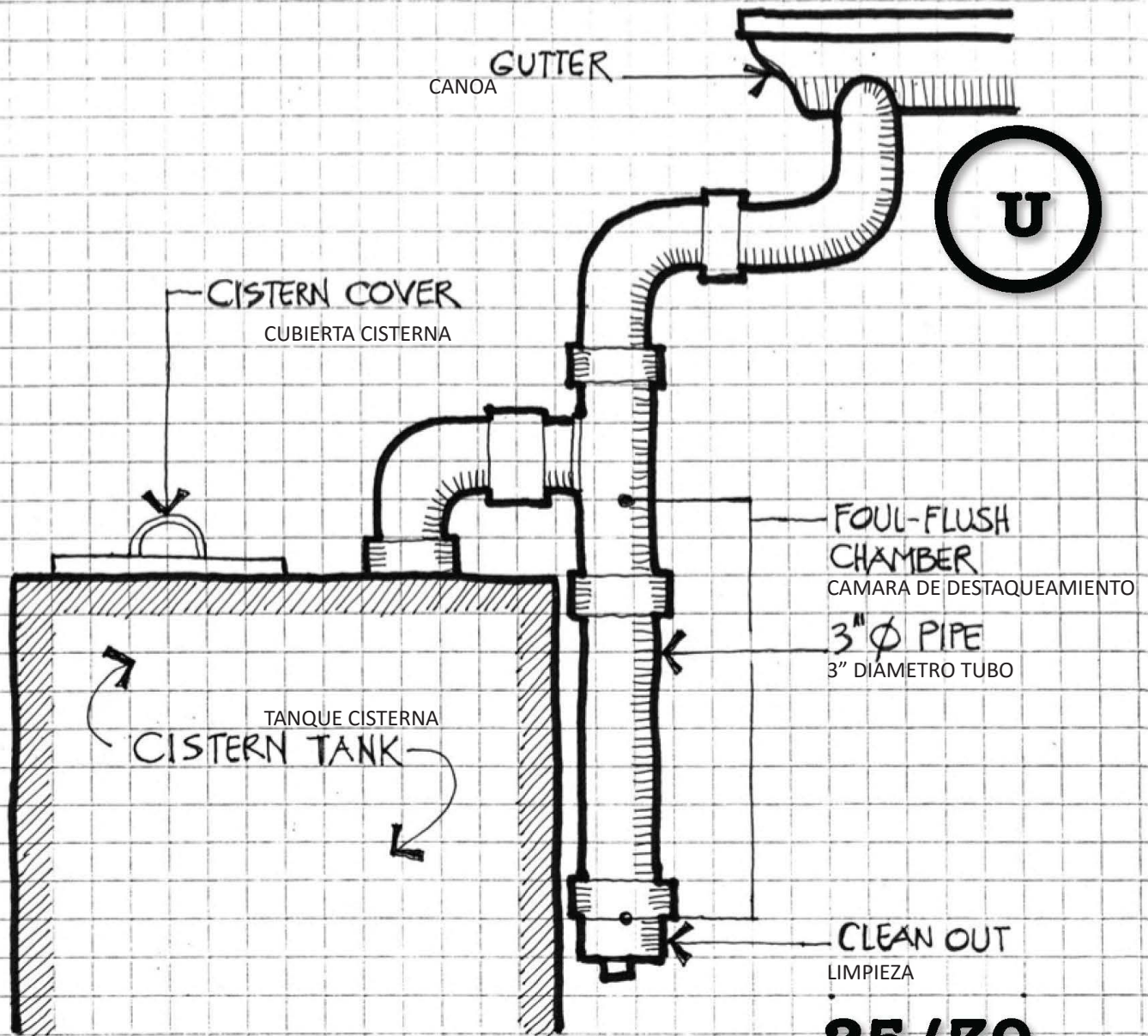
RAIN WATER HARVESTING SYSTEM

24/30

NOTES

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RAINWATER FOUL-FLUSH DEVICE

DISPOSITIVO DE DESCARGA

25/30

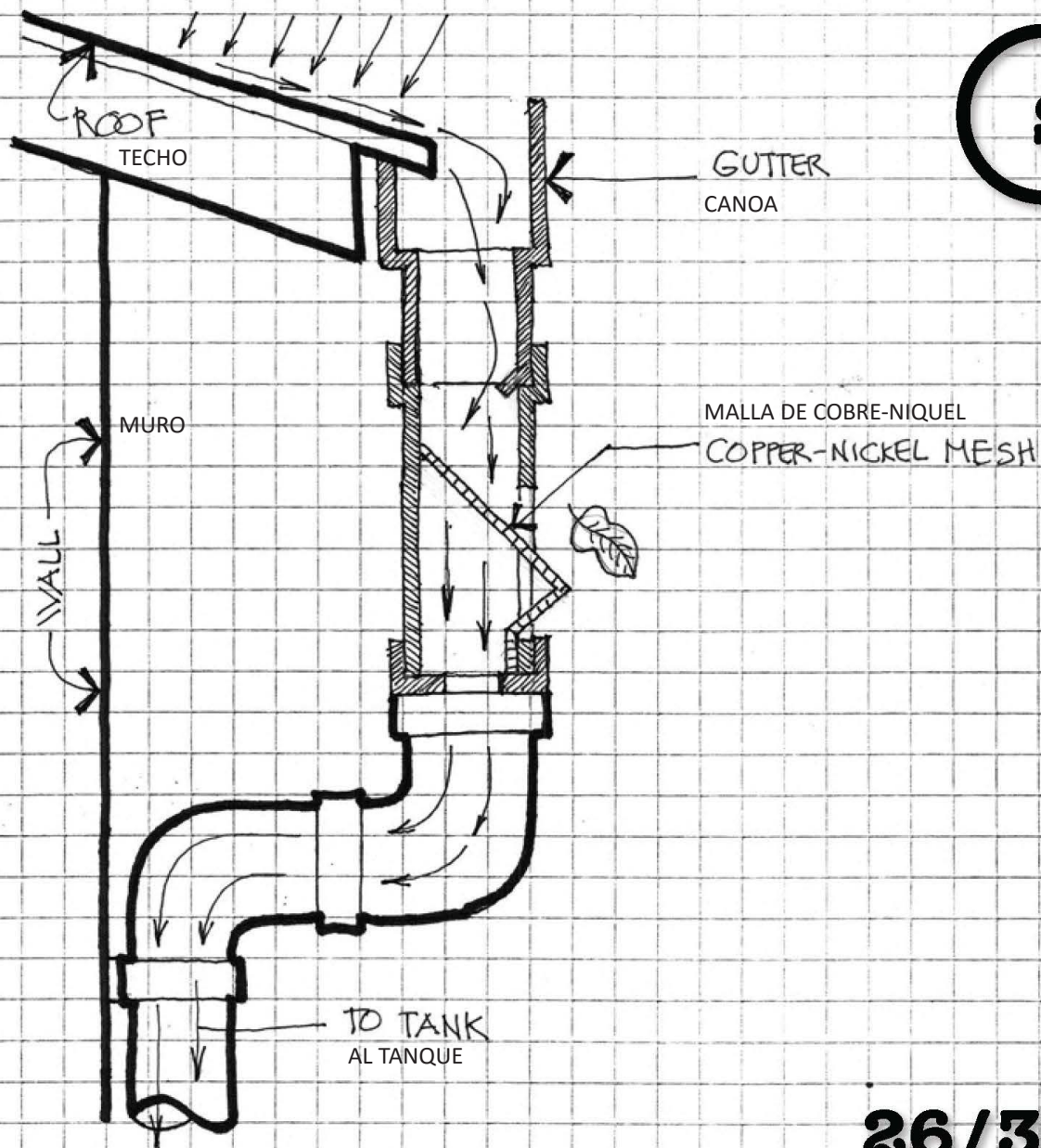
NOTES

- THIS DEVICE REQUIRES PERIODIC CLEANING OF THE FOUL-FLUSH CHAMBER

ESTE ELEMENTO REQUIERE LIMPIEZA PERIODICA DE LA CAMARA DE DESTAQUEAMIENTO

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SELF CLEANING RAINWATER FILTER

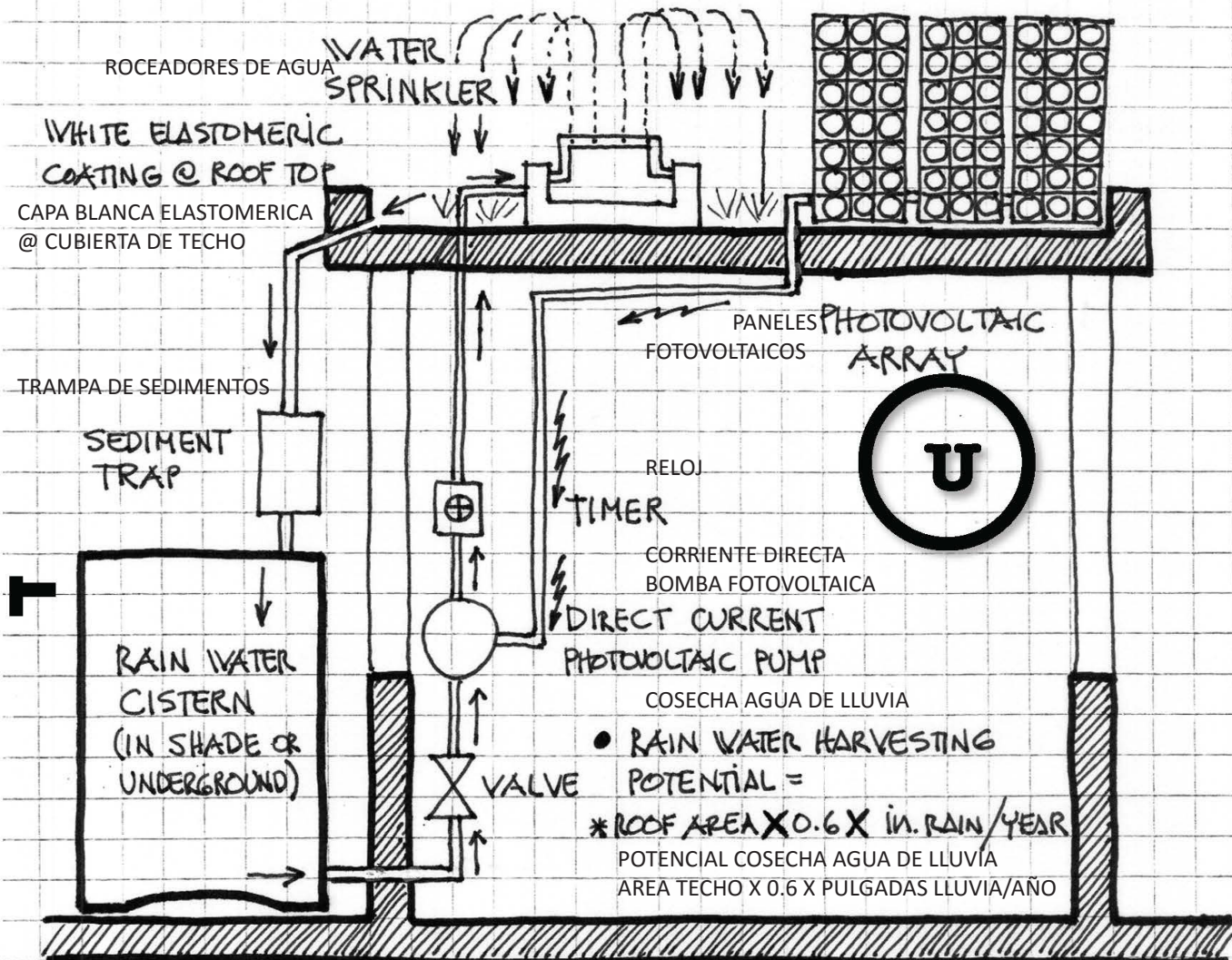
FILTRO DE AGUA DE LLUVIA AUTOLIMPIADOR

26/30

NOTES

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GREEN CONSTRUCTION DETAILS



*: ROOF AREA IS EQUIVALENT TO TOP VIEW PROJECTION.

*: AREA DE TECHO ES EQUIVALENTE A LA PROYECCION EN PLANTA

EVAPORATIVE ROOF COOLING DETAIL

DETALLE DE ENFRIAMIENTO DEL TECHO X EVAPORACION

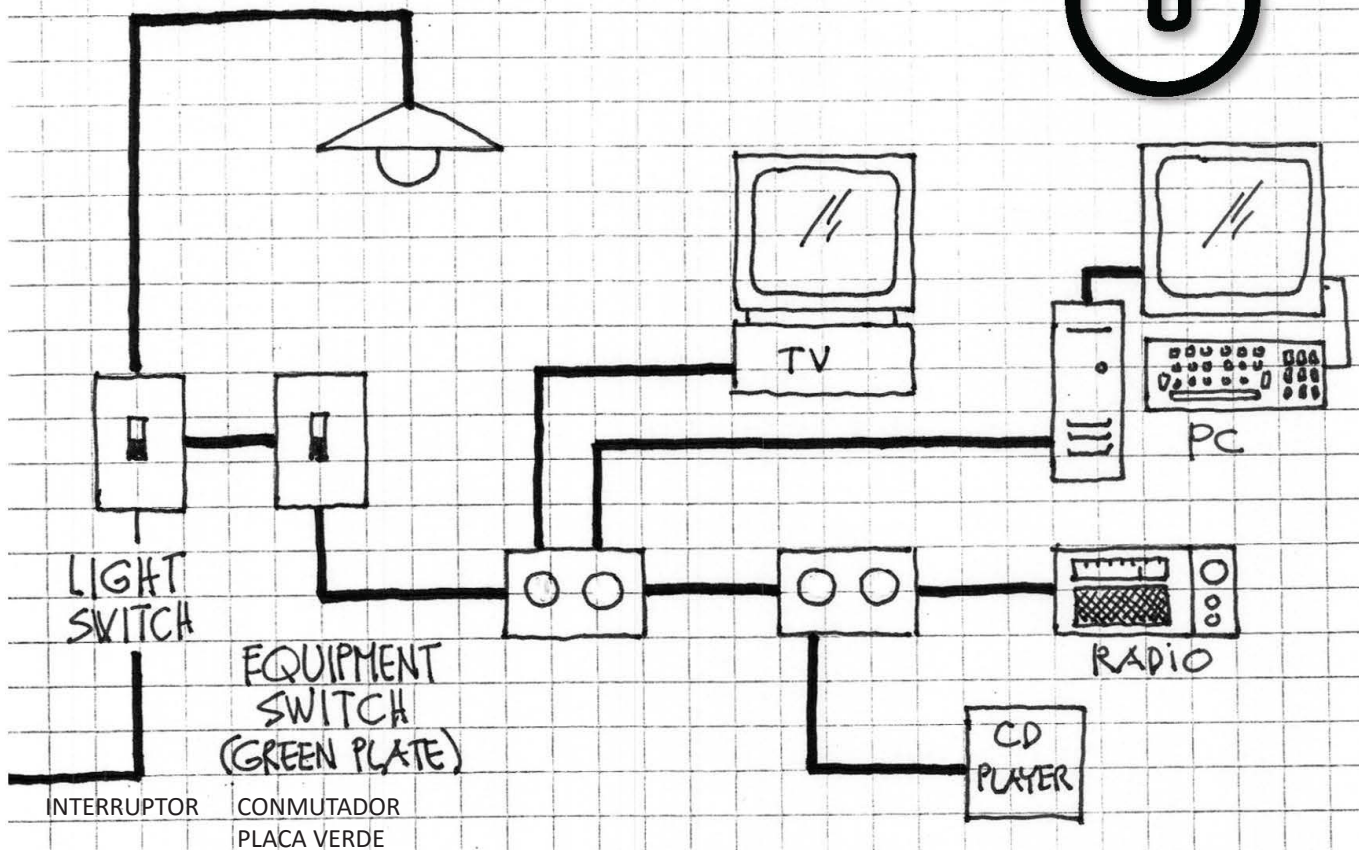
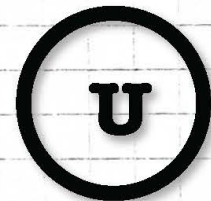
27/30

NOTES

- D.C. PUMP IS DEACTIVATED WHEN CLOUDY
- D.C. PUMP IS ACTIVATED WHEN SUNNY.
- TIMER IS PROGRAMMED FOR 1 MINUTE ACTIVATION EVERY 20 MINUTES FOR A TOTAL MAXIMUM RUNS OF 36 TIMES/DAY.

* BOMBA CD SE DESACTIVA SI ESTA NUBLADO
* BOMBA CD SE ACTIVA SI ESTA SOLEADO
* EL-RELOJ SE PROGRAMA PARA ACTIVARSE @ 20 MIN. PARA UN TOTAL DE 36 VECES AL DIA

GREEN CONSTRUCTION DETAILS



28/30

PHANTOM LOAD CIRCUIT DETAIL

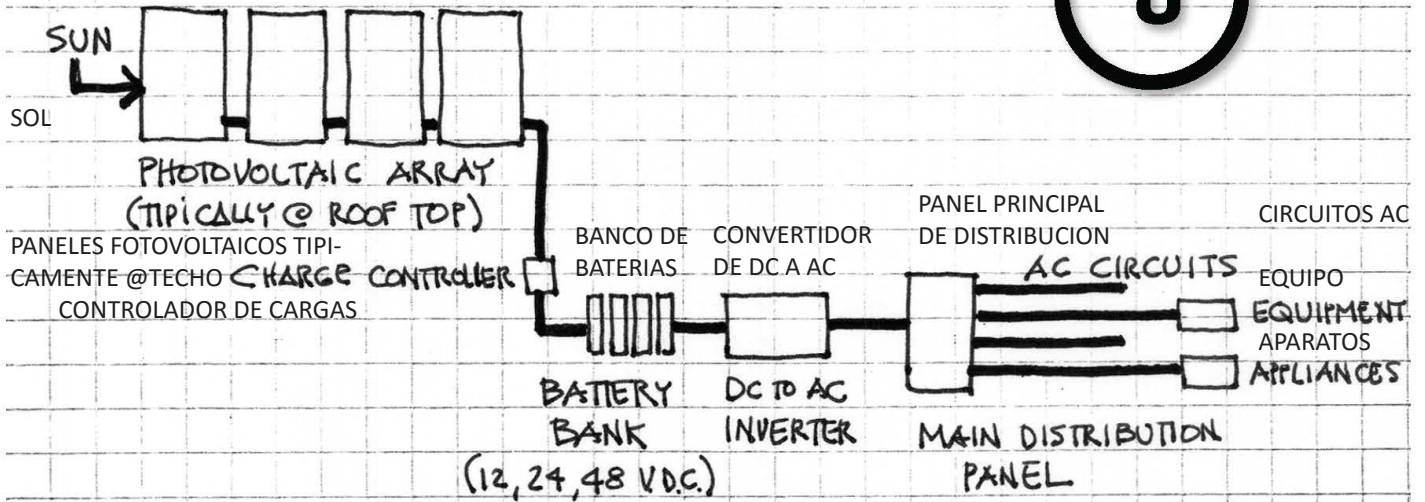
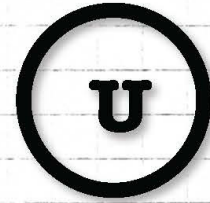
DETALLE SIMULADO DEL CIRCUITO

NOTES

- EQUIPMENT SWITCH DISCONNECTS EQUIPMENT AND/OR APPLIANCES WITH "INBEDED" PHANTOM LOADS.

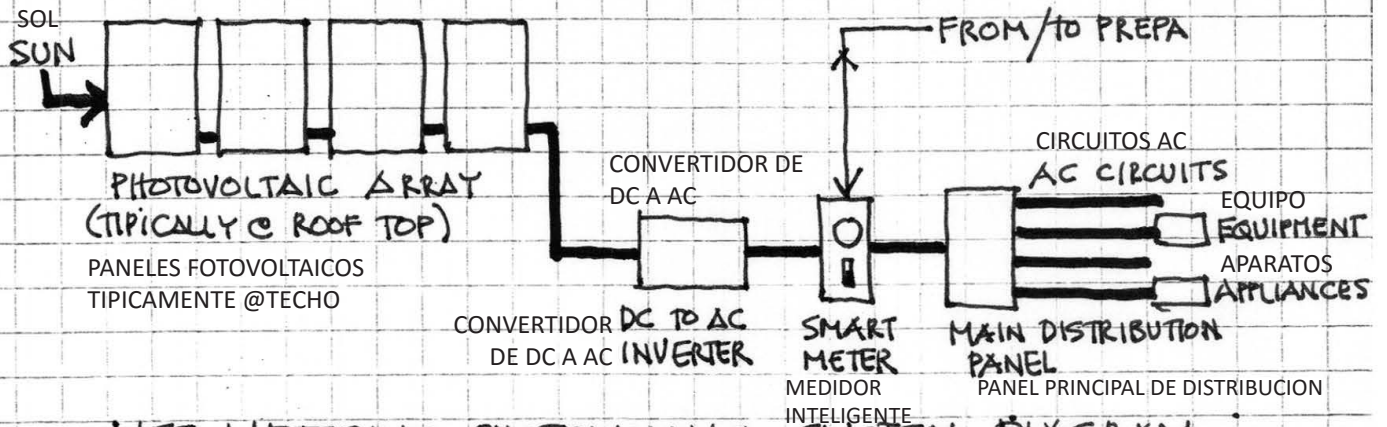
EL INTERRUPTOR DEL EQUIPO DESCONECTA AL EQUIPO Y A TODOS LOS APARATOS INCLUIDOS EN LA SIMULACION DE CARGAS

GREEN CONSTRUCTION DETAILS



AUTONOMOUS PHOTOVOLTAIC SYSTEM DIAGRAM

DIAGRAMA DEL SISTEMA FOTOVOLTAICO AUTONOMO



NET METERING PHOTOVOLTAIC SYSTEM DIAGRAM

DIAGRAMA DE MEDIDAS NETAS DEL SISTEMA

PHOTOVOLTAIC SYSTEM DIAGRAMS

29/30

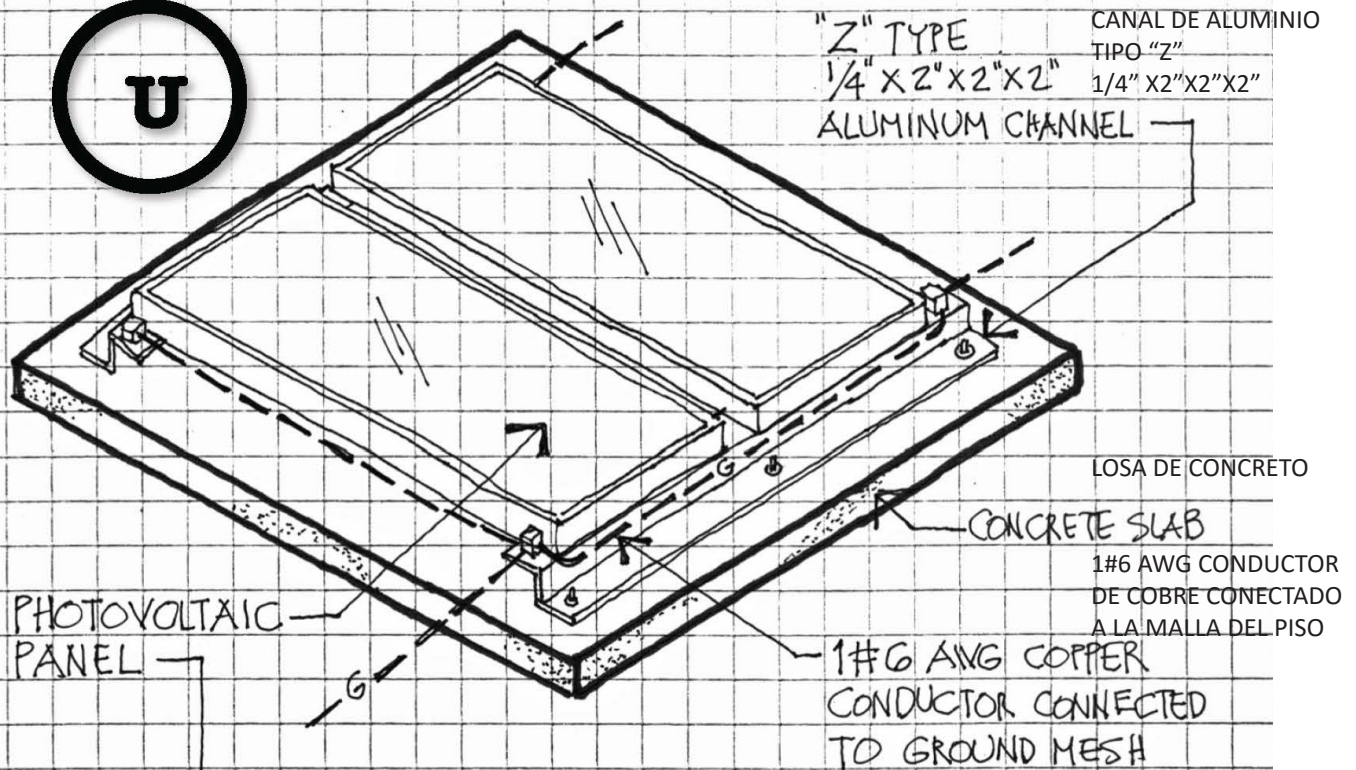
NOTES

- NET METERED SYSTEMS HAVE A SHORTER PAYBACK PERIOD AND LOWER INITIAL COSTS. ENVIRONMENTALLY SAFE DISPOSITION OF BATTERIES IS ELIMINATED.

EL SISTEMA DE MEDIDAS NETAS TIENE UN PERIODO DE RETORNO CORTO Y COSTOS INICIALES BAJOS
SE DISPONE DE OFERTA LIMITADA DE BATERIAS AMBIENTALMENTE SEGURAS

GREEN CONSTRUCTION DETAILS

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PHOTOVOLTAIC
PANEL

"Z" TYPE
1/4" X 2" X 2" X 2"
ALUMINUM CHANNEL

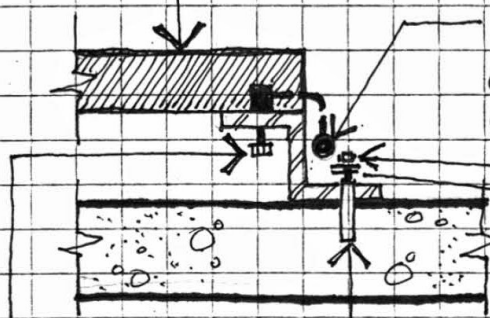
CANAL DE ALUMINIO
TIPO "Z"
1/4" X 2" X 2" X 2"

LOSA DE CONCRETO

CONCRETE SLAB

1#6 AWG CONDUCTOR
DE COBRE CONECTADO
A LA MALLA DEL PISO

1#6 AWG COPPER
CONDUCTOR CONNECTED
TO GROUND MESH



LAY-IN LUG WITH SCREW FOR MODULE
GROUNDING FOR CONNECTION OF CONTINUOUS
GROUND WIRE TO ALL MODULES

AGARRADERA HORIZONTAL
CON TORNILLO PARA CONEC-
CIONES CONTINUAS ENTERRA-
DAS Y CABLEADO PARA TODOS
LOS MODULOS

STAINLESS STEEL 1/2" NUT

TUERCA DE ACERO INOXIDABLE 1/2"

STAINLESS STEEL PRESSURE WASHER

SEGURO HIDRAULICO ACERO INOXIDABLE 1/2"

STAINLESS STEEL 1/2" HYDRAULIC ANCHOR

STAINLESS STEEL SCREW

AS PER PRODUCT PANEL MANUFACTURER

TORNILLO DE ACERO INOXIDABLE DE FABRICA

PHOTOVOLTAIC PANEL INSTALLATION

INSTALACIÓN PANEL FOTOVOLTAICO

30/30

NOTES

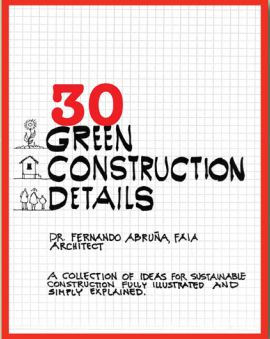
- NEOPRENE WASHER MAY BE INSTALLED AT SLAB PENETRATION FOR WATER PROOFING PURPOSES. ARANDELA NEOPRENE PUEDE INSTALARSE PARA EVITAR PENETRACION EN LOSA
- ALWAYS VERIFY MANUFACTURER'S REQUIREMENTS AND SPECIFICATIONS. VERIFICAR SIEMPRE LAS ESPECIFICACIONES TECNICAS

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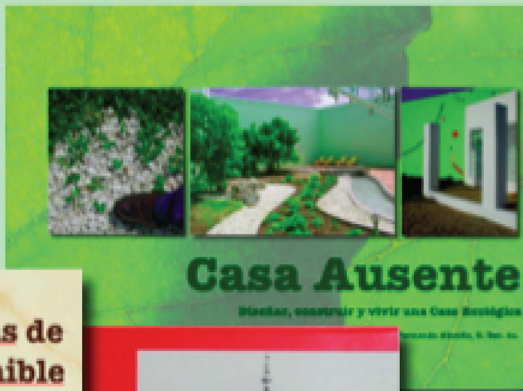
Other books by the author

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**Textos de Sustentabilidad
para Puerto Rico**

\$20



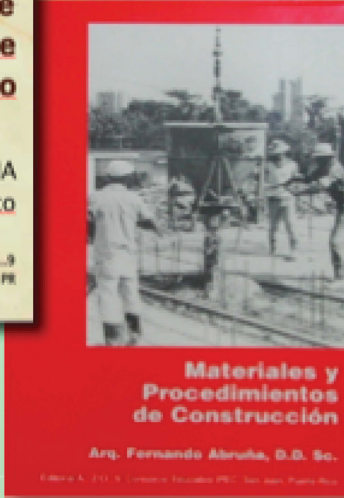
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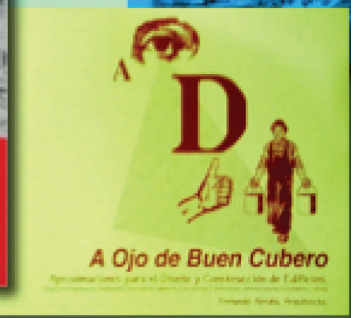
\$20



\$30



\$15



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00902- 2030

NOTES

Add 20% to cover handling and mailing costs.

GREEN CONSTRUCTION DETAILS

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