

**Ministry of Housing, Construction
and Sanitation (MVCS)
Republic of Peru**

**The Study
on
Housing Reconstruction with
Seismic-resistant Houses
in
the Republic of Peru**

Final Report

Annex 2

May 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

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LIST OF ABBREVIATIONS

ADRA	The Adventist Development and Relief Agency
APCI	Peruvian International Cooperation Agency
BANMAT	Bank of Materials
BFH	Family Housing Bonus
B/Q	Bill of Quantities
CARE	The Cooperative for American Remittance to Europe
CAPECO	Peruvian Chamber of Construction
CISMID	Japan-Peru Center for Earthquake Engineering and Disaster Mitigation
CMPAD	Multi-sectoral Commission for Disaster Prevention and Response
COE	Emergency Operation Center
COFOPRI	Commission for the Formalization of Informal Property
ESTABS	Extended Tri-Dimension Analysis for Building Structures
FORSUR	Fund for the Reconstruction of the South
FONCODES	National Cooperation Fund for Social Development
GDP	Gross Domestic Product
IGP	Geophysics Institute of Peru
IHD	Human Development Index
INDECI	National Institute of Civil Defense
IMP	Metropolitan Institute of Planning
INEI	National Institute of Statistics and Information
ISC	Superior Institute of the Construction
ITDGT	The Intermediate Technology Development Group
JICA	Japan International Cooperation Agency
MMI	Modified Mercalli Intensity
MVCS	Ministry of Housing, Construction and Sanitation
NGO	Non-Governmental Organization
PCM	Presidency of the Ministry Council
PRA	Participatory Rural Appraisal
RUCP	Pontifical Catholic University of Peru
RC	Reinforced Concrete
SEDAPAL	Lima Water and Sewer Company
SENCICO	National Training Service in Construction PERU
SINADECI	National System of Civil Defense
SUNARP	National Superintendency of Public Registration
SNIP	National System of Public Investment
TUPA	Exclusive Text for Administrative Procedures
UN	United Nations
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund

VOLUME 4-1

Promotion of Safer Housing Construction

(Cut Model House Construction)

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CHAPTER 1 BACKGROUND AND OBJECTIVES OF THE PILOT PROJECT 2-1

On 15th August 2007, a big earthquake hit the coast of Ica Region leaving in its wake a lot of victims and material damages. According to the INEI a total of 52,134 houses were collapsed as a consequence of this earthquake.

The results of the building survey, made by the JICA Study Team, reveal the quick reconstruction needs of safer housing using confined masonry to reduce also the risk of damage from future earthquakes. However, there are many victims living in poverty who do not have the correct knowledge of earthquake prevention for their own houses.

Pilot Project 2.1 aims at promoting safer housing construction after the earthquake by training of minimum requirements for safer housing through construction of Scale model housing

Pilot Project 2.1 was carried out by SENCICO (National Training Service in Construction PERU) contracted by the JICA Study Team on the Pilot Project. The JICA Study Team provided SENCICO with the drawings of a Scale model house based on the minimum requirements for safer housing using confined masonry and supervised SENCICO's work.

CHAPTER 2 DESCRIPTION OF THE PROJECT 2-1

2.1. Target Area

The target area of Pilot Project 2.1 was Pueblo Nuevo district in Chincha province of Ica region. The Pilot Project site, where training of minimum requirements for safer housing through construction of Scale model housing was held, was the vacant lot of the public market located near the municipal hall.

2.2. Project Component

2.2.1. Preparation Stage

Before contracting with SENCICO on Pilot Project 2.1, the JICA Study Team formulated a training concept. The training concept is that training sessions are not for construction itself of safer housing but for monitoring construction of safer housing. Confined masonry was the targeted house structure of training. Trainees were ordinary people who have no construction knowledge. Therefore, the idea of Scale model housing, which leaves the construction work unfinished according to building construction process, was applied to the training concept. The Scale model house proved convenient for the trainees to easily understand the minimum requirements for safer housing for each construction process. The drawings of a scale model house were prepared by the JICA Study Team (See Appendix 1).

At the preparation stage, SENCICOI-Ica, which is the Ica regional organization of SENCICO, prepared an instruction manual (See Appendix 2) and a participant textbook (See Appendix 3) under the instruction and supervision of the JICA Study Team. The trainees were selected by SENCICO-Ica after Pueblo Nuevo municipality had collected candidates. The JICA Study Team requested the municipality to submit a list of trainees in order to select the trainees smoothly.

2.2.2. Implementation Stage

During the implementation stage, training on the dissemination activities of safer housing was carried out by SENCICO-Ica. The training sessions consist of the 16 units of the participant's textbook. Twenty trainees learned minimum requirements for safer housing using confined masonry while they constructed a full sized Scale model house under the management of SENCICO-Ica. According to the contract with the JICA Study Team, SENCICO-Ica provided trainers, textbooks and some safety wear for construction. The trainees were examined to confirm their understanding of the training sessions every week by trainers dispatched from SENCICO-Ica. In addition, JICA Study Team examined the trainees twice: in the middle and at the end of training.

2.3. Principle Idea of Training made Use of Scale Model House

Training made use of Scale model house was guided by the following principles.

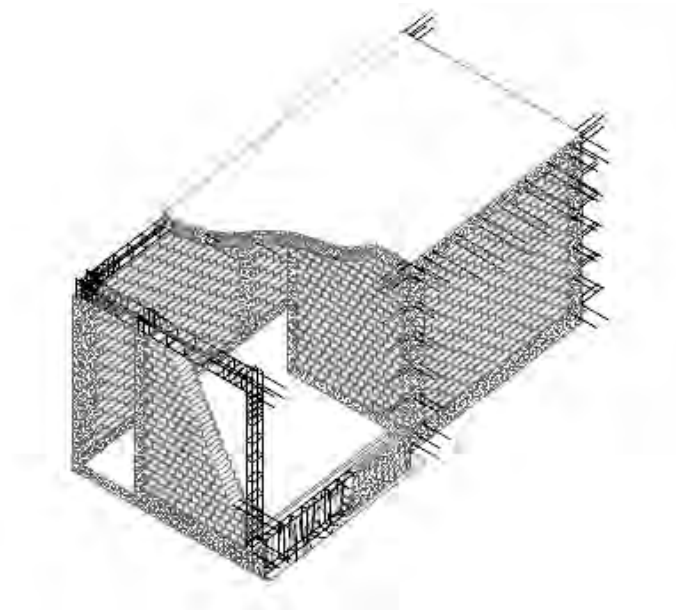
(1) Dissemination of minimum requirements for safer housing

The minimum requirements for safer housing using confined masonry are necessary to disseminate people who want to reconstruct their own houses after an earthquake.

(2) Scale model house

Scale model house is a realistic sized building of 3 meters wide and 6 meters long and 2.5 meters high using confined masonry as shown in Figure 2.1. The house consists of two parts: a completed part of construction and an incomplete part of construction. The incomplete part exposes the following construction parts: excavation and foundation, column with steel assembly and brick wall, ring beam, and roofing. Those incomplete parts can show the minimum requirements of safer housing of the construction parts.

Therefore not only trainees but also visitors can see and get to know the minimum requirements from the structure in the Scale model house.



Source: Study on Housing Reconstruction with Seismic-resistance Houses in the Republic of Peru, JICA Study Team

Figure 2.1 Isometric Drawing of Scale Model House

(3) Training of the Minimum Requirements for Safer Housing using Confined Masonry through Construction of a Scale Model House

Pilot Project 2.1 was carried out at the same place as Pilot Project 2.2; it which consists of several events such as one-day training, role playing, and video show of shaking table. Pilot Project 2.1 also created a showcase indicating the minimum requirements for safer housing

using confined masonry. The showcase gives trainees of Pilot Project 2.2 and passers-by a chance to get to know the minimum requirements visually.

The trainees of Pilot Project 2.2 could maintain their attention by participation in real construction of safer housing and learn the minimum requirements practically due to the realistic sized parts of Scale model house. The effect of training including the participation in the construction is much higher than lecture-type training.

2.4. Schedule

Pilot Project 2.1 was implemented as the following schedule shows below.

Table 2.1 Work Schedule of Pilot Project 2.1 (at preparation stage)

No.	WORK DESCRIPTION	schedule																									
		2008/8/18	2008/8/19	2008/8/20	2008/8/21	2008/8/22	2008/8/23	2008/8/24	2008/8/25	2008/8/26	2008/8/27	2008/8/28	2008/8/29	2008/8/30	2008/8/31	2008/9/1	2008/9/2	2008/9/3	2008/9/4	2008/9/5	2008/9/6	2008/9/7	2008/9/8	2008/9/9	2008/9/10	2008/9/11	2008/9/12
1	HAND IN OF TRAINING COURSE SCHEDULE AND SYLLABUS																										
2	MINIMUM REQUIREMENTS SUBMISSION FROM JICA																										
3	SUBMISSION OF DRAWINGS OF CUT MODEL HOUSE TO SENCICO																										
4	MINIMUM REQUIREMENTS FINAL FROM JICA STUDY TEAM																										
5	FINAL DRAWINGS OF CUT MODEL HOUSE																										
6	THE PARTICIPANT MANUAL PREPARED BY SENCICO ON SUPERVISION OF JICA STUDY TEAM																										
7	THE INSTRUCTION MANUAL PREPARED BY SENCICO ON SUPERVISION OF JICA STUDY TEAM																										
8	MEETING IN SENCICO WITH SUPERVISOR, INSTRUCTOR AND PARTICIPANTS																										
9	CONTENT AND ELABORATION OF TRAINING COURSE																										
10	EDITION OF TRAINING COURSE POSTER																										
11	PARTICIPANTS COLLECTION																										
12	PARTICIPANTS SELECTION																										
13	PARTICIPANTS MANUAL PRESENTATION AND PRINTING																										
14	INSTRUCTOR MANUAL PRESENTATION AND PRINTING																										
15	PARTICIPANT MANUAL PRINTING (English)																										
16	INSTRUCTOR MANUAL PRINTING (English)																										
17	MAKING OF SCALE MODL OF CUT MODEL HOUSE																										
18	TRAINING COURSE FOR PUEBLO NUEVO PARTICIPANTS																										
19	MONITORING OF TRAINING COURSE FOR PUEBLO NUEVO PARTICIPANTS																										
20	FINAL REPORT (spanish)																										

Source: Study on Housing Reconstruction with Seismic-resistance Houses in the Republic of Peru, JICA Study Team

Table 2.2 Work Schedule of Pilot Project 2.1 (at implementation stage)

N°	Training unit	Lesson hours	SEPTEMBER															OCTOBER															NOVEMBER																			
			M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S								
			15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			
1	KNOWING YOUR LAND AND READING THE DRAWINGS	20																																																		
2	CLEANING, LEVELING AND TRACING ON YOUR LAND	18																																																		
3	EXCAVATING THE DITCH	10																																																		
4	MAKING THE CONFINED COLUMN	22																																																		
5	BUILDING THE FOUNDATION	10																																																		
6	MAKING THE FRAMEWORK FOR RC TIE BEAM	20																																																		
7	MAKING FORMWORK FOR TIE BEAM	20																																																		
8	BUILDING THE TIE BEAM	10																																																		
9	INSTALLING THE FIRST BRICK ROWS	9																																																		
10	BUILDING THE WALLS	27																																																		
11	MAKING THE FRAMEWORK AND POURING THE MIX IN CONFINED COLUMN	20																																																		
12	MAKING THE FORMWORK FOR RING BEAM	20																																																		
13	MAKING THE FRAMEWORK FOR RING BEAM	18																																																		
14	MAKING THE FORMWORK FOR LIGHT SLAB	22																																																		
15	MAKING THE FRAMEWORK FOR LIGHT SLAB	18																																																		
16	BUILDING THE LIGH SLAB	12																																																		
COURSE TOTAL		276																																																		

Source: Study on Housing Reconstruction with Seismic-resistance Houses in the Republic of Peru, JICA Study Team

CHAPTER 3 OUTLINES OF OUTCOMES OF THE PROJECT

3.1. Training Materials

3.1.1. Drawings of a Scale Model House

Drawings were prepared based on the Scale model house using confined masonry which presents the minimum requirements for safer housing.

3.1.2. Instruction Manual

The instruction manual of the project was prepared based on a regular instruction manual developed by SENCICO-ICA. It consists of training system and curricular program including lesson plan on the instruction manual. The instruction manual mainly describes functions of trainer, the basic policy of planning and programming the education action, and developing the course program.

3.1.3. Participant Textbook

Participant textbook has 16 training units which follow the construction process. In the textbook, each unit shows an image of a construction step and the work in conformity with the minimum requirements; it has many illustrations for readers who have no experience of housing construction.

Unit 1: Knowing your land and reading the drawings

Unit 2: Cleaning, leveling and tracing land

Unit 3: Excavating for the foundation

Unit 4: Making confined column

Unit 5: Building foundation

Unit 6: Making framework for reinforced tie beam

Unit 7: Making formwork for reinforced tie beam

Unit 8: Building the tie beam

Unit 9: Installing the first brick rows of the wall

Unit 10: Building the wall

Unit 11: Making the framework and pouring concrete in confined columns

Unit 12: Making the ring beam formwork

Unit 13: Making the framework for ring beam

Unit 14: Making the light slab formwork

Unit 15: Making the framework for light slab

Unit 16: Building light slab

3.1.4. Scale Model House

A Scale model house is made for trainees to easily understand each part of the structure during their training. The model is made with a scale of 1:16.6. The model is displayed for all people coming to the project site.

3.1.5. Introduction Materials of Training of Minimum Requirements for Safer Housing through Construction of Scale Model House

The JICA Study Team prepared both a photo collection and a video on the training sessions by training unit. Those can be used as the dissemination materials of the minimum requirements for safer housing using confined masonry.

3.2. Results of Training of Minimum Requirements for Safer Housing Through Construction of Scale Model House

(1) Participants of training

Twenty (20) participants out of forty four (44) nominees were selected and announced by a local TV and public board of the municipal hall before start of training. However; only twelve (12) participants came to the training place on the first day of training. After the JICA Study Team contacted directly with or gave phone calls to the remaining participants about coming to training, four (4) more participants joined from the third day. Since there was still lack of participants, the shortage of participants was filled by contacting with the persons who were not originally selected among the nominees. The list of attendees is shown in the Appendix 4.

(2) Examination results made by SENCICO-Ica

SENCICO-Ica conducted examination after every training unit. Sixty (60) percent was the passing mark on the examination. The examination results are shown in Table 3.1. The number of trainees answering the examination correctly was about 70% in all units.

Table 3.1 Examination results made by SENCICO-Ica

N°	Training unit	Percent of trainee number answered correctly (%)
1	KNOWING YOUR LAND AND READING THE DRAWINGS	71
2	CLEANING, LEVELING AND TRACING ON YOUR LAND	72
3	EXCAVATING THE DITCH	72
4	MAKING THE CONFINED COLUMN	72
5	BUILDING THE FOUNDATION	72
6	MAKING THE FRAMEWORK FOR RC TIE BEAM	72
7	MAKING FORMWORK FOR TIE BEAM	72
8	BUILDING THE TIE BEAM	72
9	INSTALLING THE FIRST BRICK ROWS	71
10	BUILDING THE WALLS	71
11	MAKING THE FRAMEWORK AND POURING THE MIX IN CONFINED COLUMN	73
12	MAKING THE FORMWORK FOR RING BEAM	71
13	MAKING THE FRAMEWORK FOR RING BEAM	72
14	MAKING THE FORMWORK FOR LIGHT SLAB	72
15	MAKING THE FRAMEWORK FOR LIGHT SLAB	70
16	BUILDING THE LIGTH SLAB	72
Unit Total		71.6

Source: Study on Housing Reconstruction with Seismic-resistance Houses in the Republic of Peru, JICA Study Team

(3) Examination results made by JICA Study Team

In addition to the examination made by SENCICO-Ica, the JICA Study Team conducted an examination of training sessions twice. The results of the examinations are shown in Table 3.2. The questions with lower correct number of answers were the following.

Q.4 (soil type) was 5% in the first exam. and 20% in the second exam. Q.5 (minimum size of foundation) was 60% in the first. Q.16 (concreting column) was 65% in the second exam. Q.21 (brick laying) was 65% in the second exam. Q.23 (Overlapping column in first floor) was 40% in the second exam. Correct percent of answers in the other questions was 70% or more.

Table 3.2 Results of the training examination made by JICA Study Team

No.	Question	Ratio of correct answers	
		First examination	Second examination
1	What do you understand by safer houses?	100%	
2	Which are the three major factors of minimum requirements for safer housing?	95%	
3	How important is the quantity of water in the safer housing construction?	95%	70%
4	Which type of soil is not good to build your house?	5%	20%
5	Which is minimum depth and minimum wide of the foundation?	60%	
6	Which is the minimum distribution of hoops in a column?	100%	100%
7	What is the correct concrete proportion for a foundation?	95%	
8	If the ditch bottom is difficult to level, which solution is correct?	100%	95%
9	In case of which type of soil should a tie beam reinforced?	100%	100%
10	What is the reason to draw cross lines on the foundation surface during forge (before hardening) ?	100%	95%
11	What is the correct concrete proportion for a RC tie beam?	70%	95%
12	What is the best procedure to prepare concrete?		85%
13	What is the correct concrete proportion for column, ring beam and light concrete slab?		90%
14	Why is it important to wet the concrete (curing) after the formwork is taken out?		100%
15	What is it important to homogenize the fresh concrete immediately after pouring?		100%
16	Complete the following sentence? Concrete pouring in a column shall be done from-----		65%
17	How thick is the correct mortar mix in a masonry wall?		100%
18	How long is the maximum distance between columns in case of bricks installed in the stretcher bond mode?		95%
19	How thick is the correct concrete covering when the finish is plaster or polished surface?		90%
20	Where is the critical zone for column in which hoops have to begin to be installed?		90%
21	Why is it important to lay brick row without mortar in a wall before constructing the wall?		65%
22	What is the best connection system between a wall and a column?		100%
23	Is it possible to overlap steel reinforcement bars in a first floor column?		40%
24	Why is it important to pour concrete the ring beam and light concrete slab together?		95%

Source: Study on Housing Reconstruction with Seismic-resistance Houses in the Republic of Peru, JICA Study Team

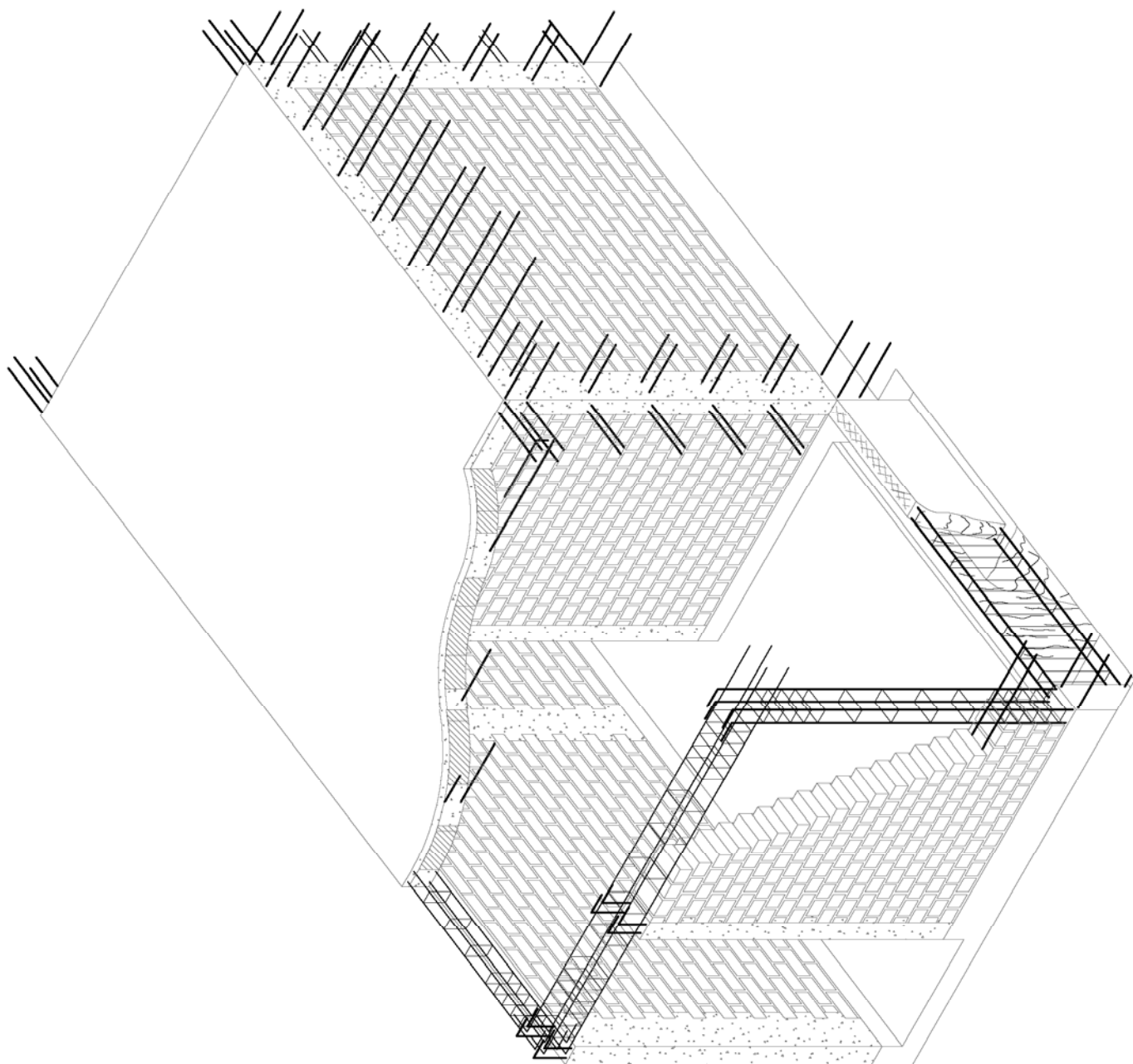
VOLUME 4-1

APPENDIX

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- APPENDIX 12. SAMPLE OF CERTIFICATE OF COMPLETING TRAINING OF MINIMUM REQUIREMENTS THROUGH CONSTRUCTION OF SCALE MODEL HOUSING

Appendix 1

Drawing of a Scale Model House





Agencia Internacional de Cooperación Japonesa



PERÚ

Ministerio
de Vivienda, Construcción
y Saneamiento

**CONCIENTIZACION ACERCA DE VIVIENDAS SEGURAS
PARA EL ESTUDIO DE RECONSTRUCCION CON VIVIENDAS
SISMORRESISTENTES EN LA REPUBLICA DEL PERU**

PLANOS DE LA VIVIENDA CON ESTRUCTURA EXPUESTA

JICA STUDY TEAM

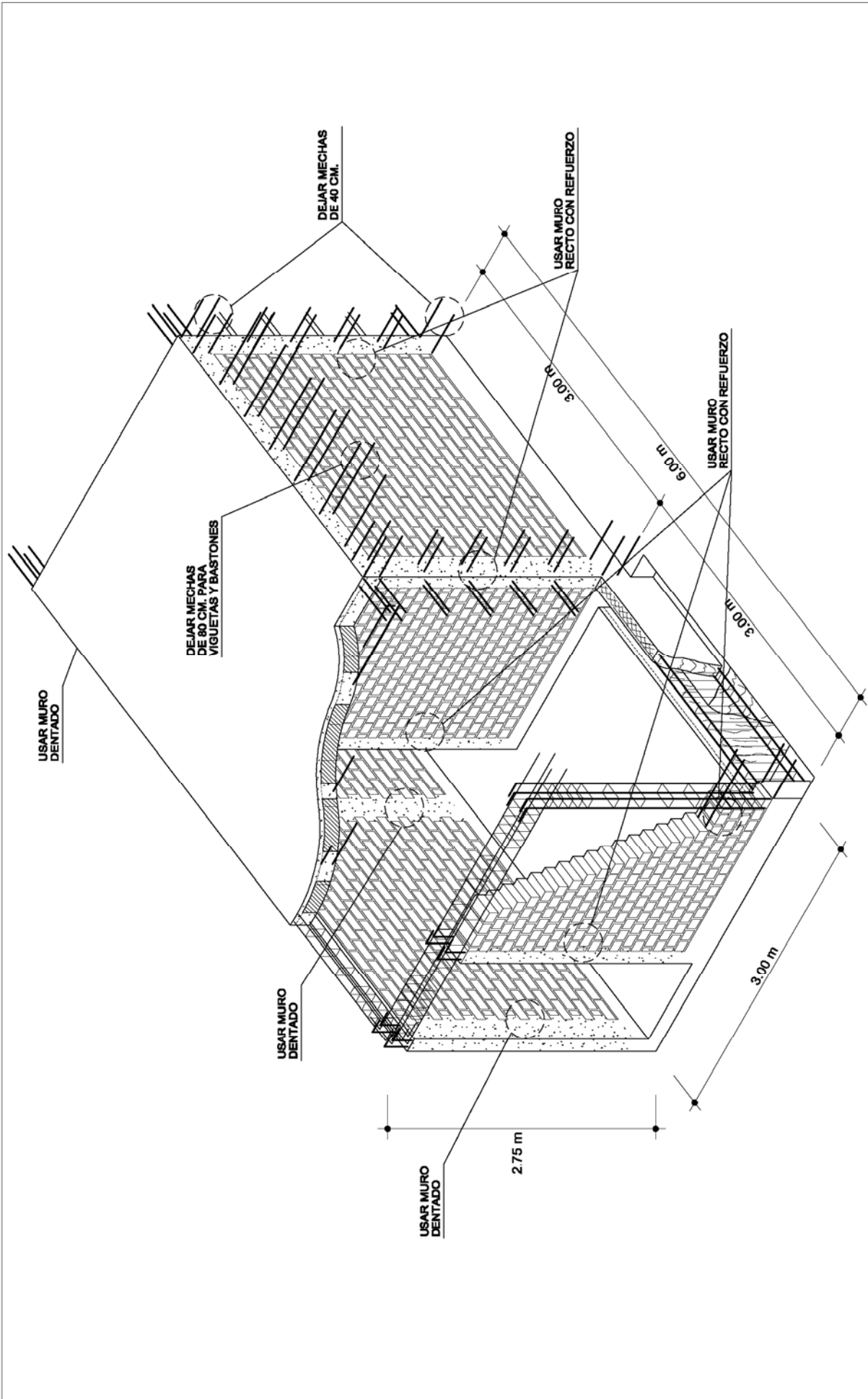
27 DE AGOSTO DE 2008

**PROYECTO PILOTO N° 2.1
(ICA-PERU)**

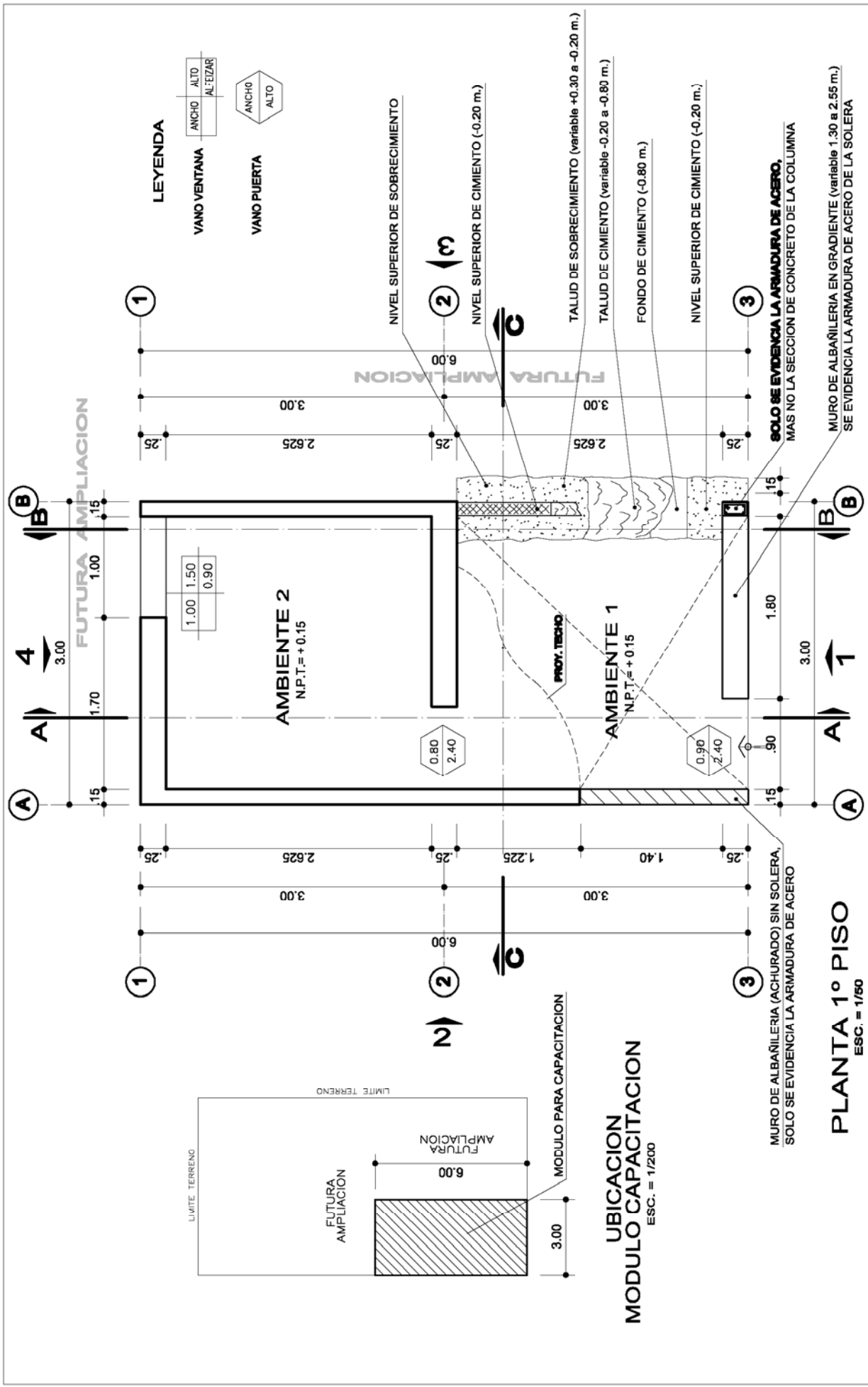
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LAMINA N°:

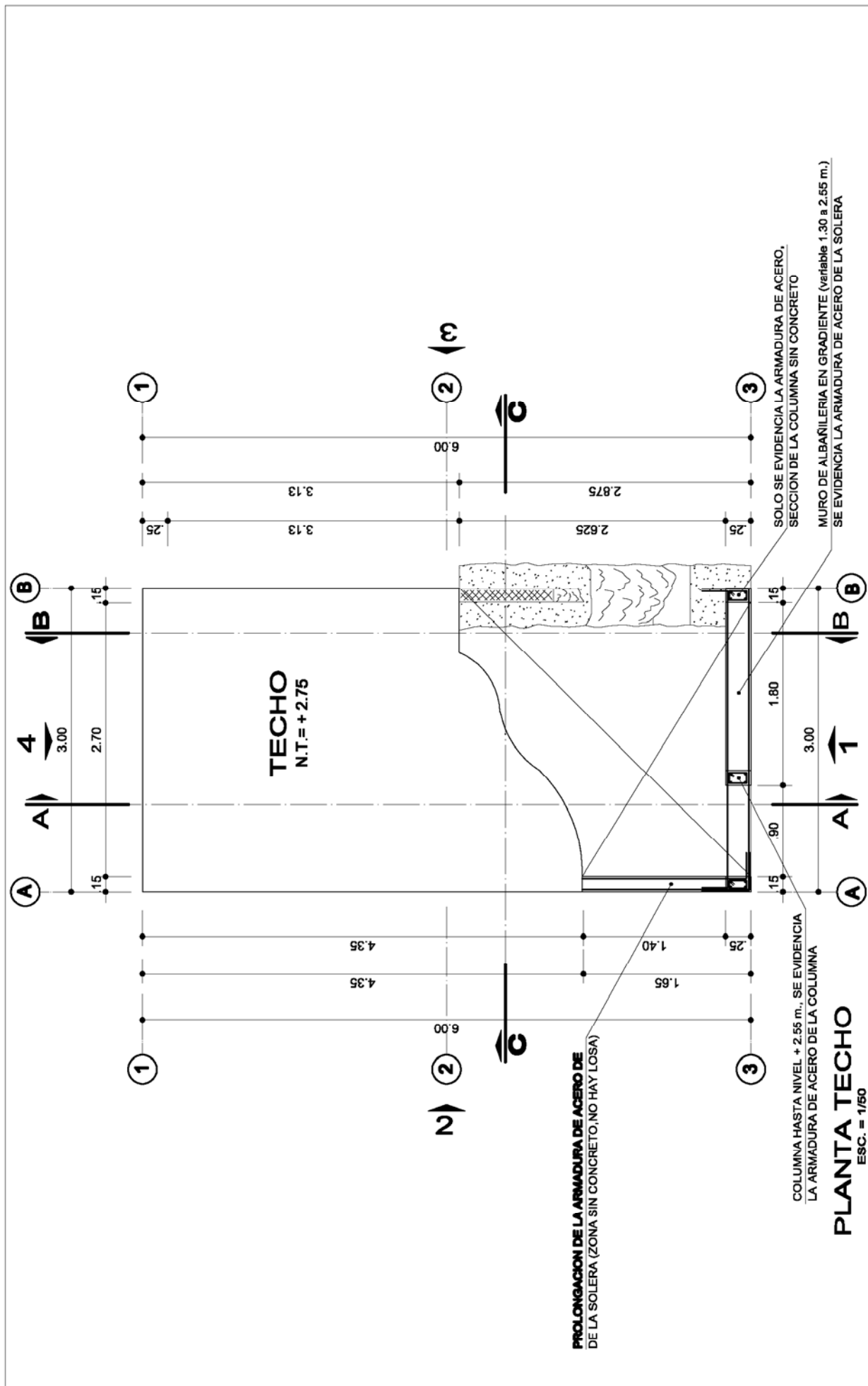
- ISOMETRIA	03
- PLANO DE PLANTA 1° PISO	04
- PLANO DE PLANTA TECHO	05
- PLANO DE ELEVACIONES	06
- PLANO DE CORTES	07
- PLANO DE CIMENTACION Y DETALLES	08
- PLANO DE DETALLES DE CIMENTACION	09
- PLANO DE ENCOFRADO TECHO, DETALLES	10
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Concientización Acerca de Viviendas Seguras (Proyecto Piloto N° 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú		
JICA STUDY TEAM	LAMINA N°: 03	NOMBRE DE LAMINA : ISOMETRIA

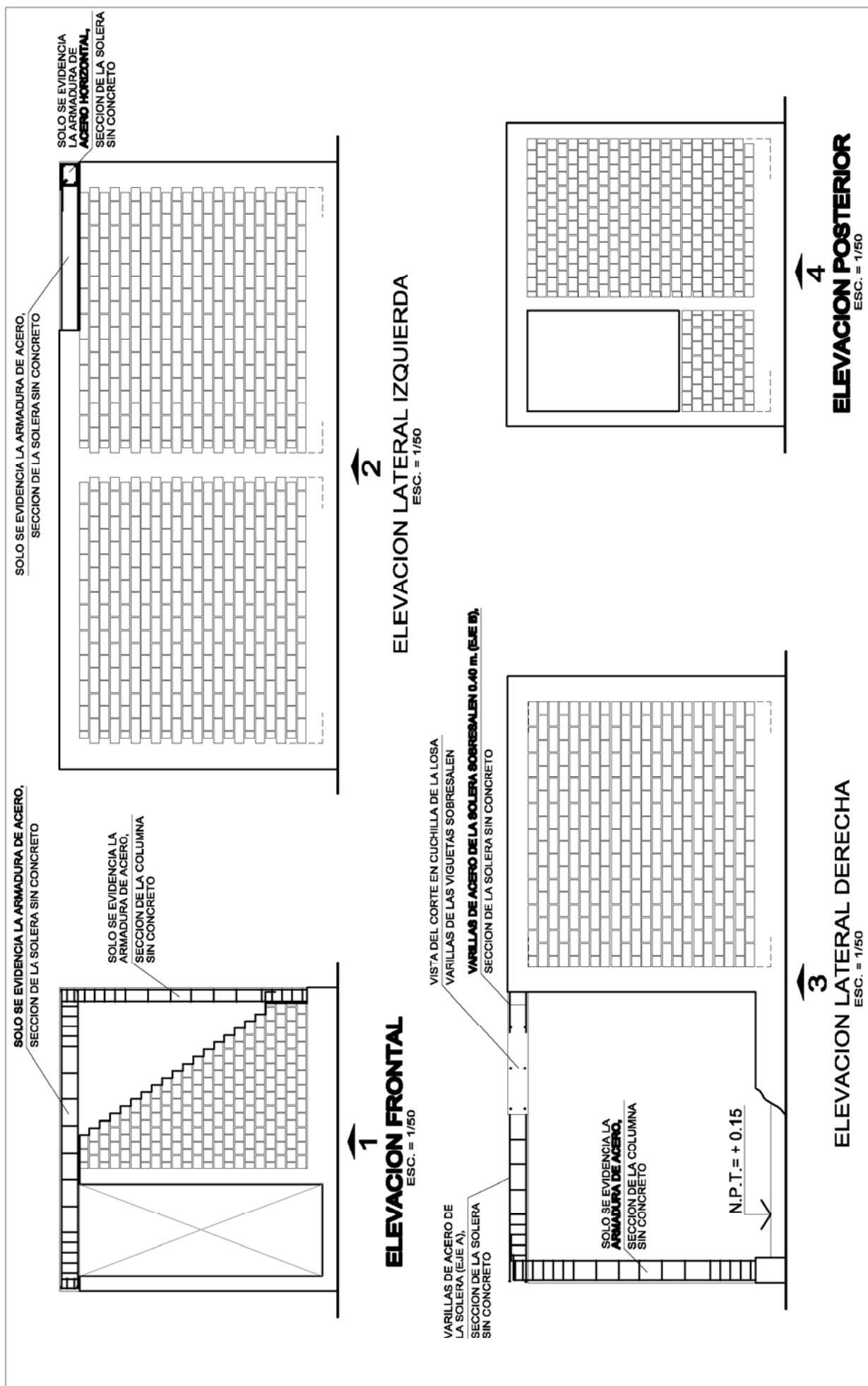


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JICA STUDY TEAM	PLANTA 1° PISO
LAMINA N° : 04	NOMBRE DE LAMINA :

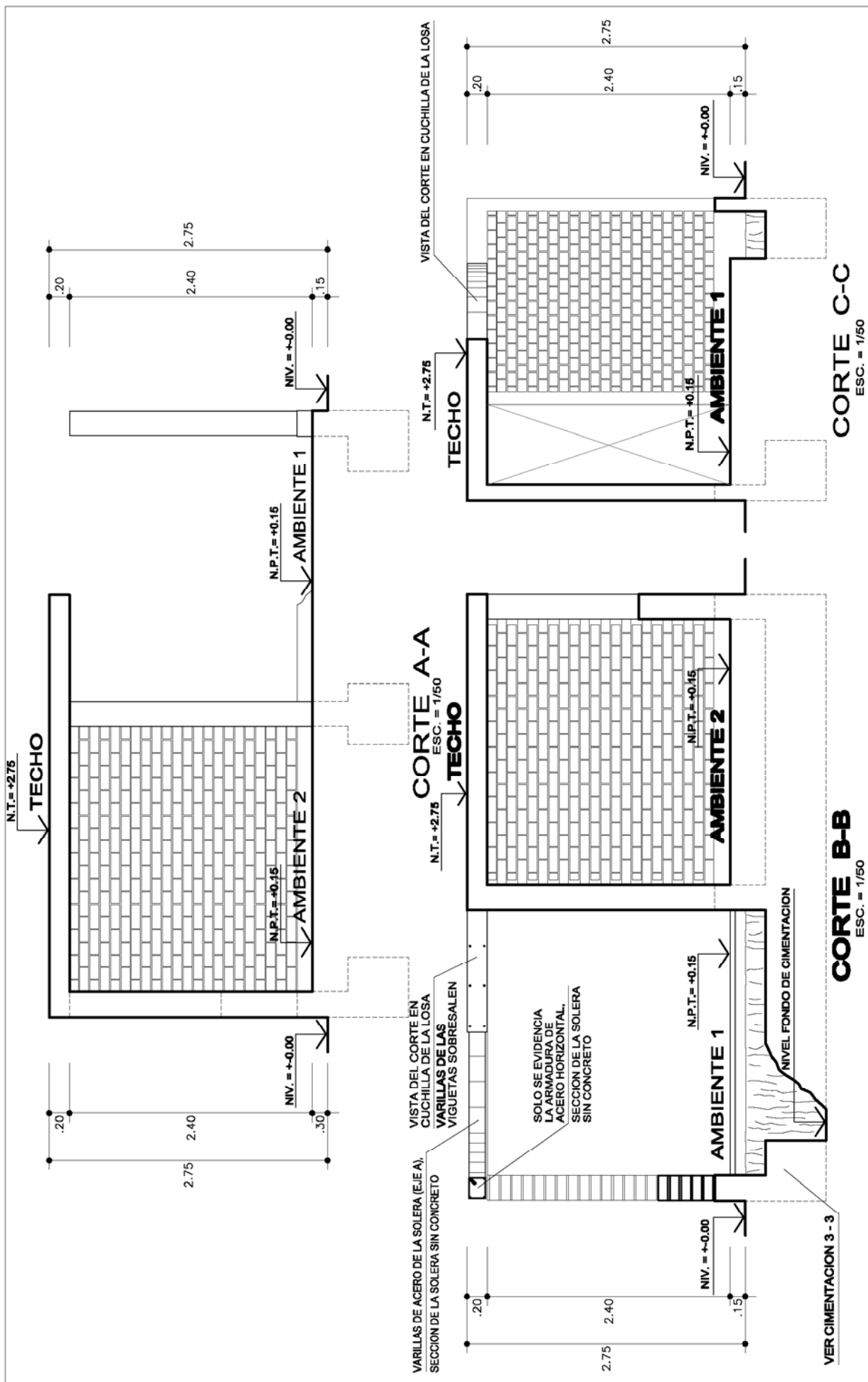


Concientización Acerca de Viviendas Seguras (Proyecto Piloto N° 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú

JICA STUDY TEAM	LAMINA N°: 05	NOMBRE DE LAMINA: PLANTA TECHO
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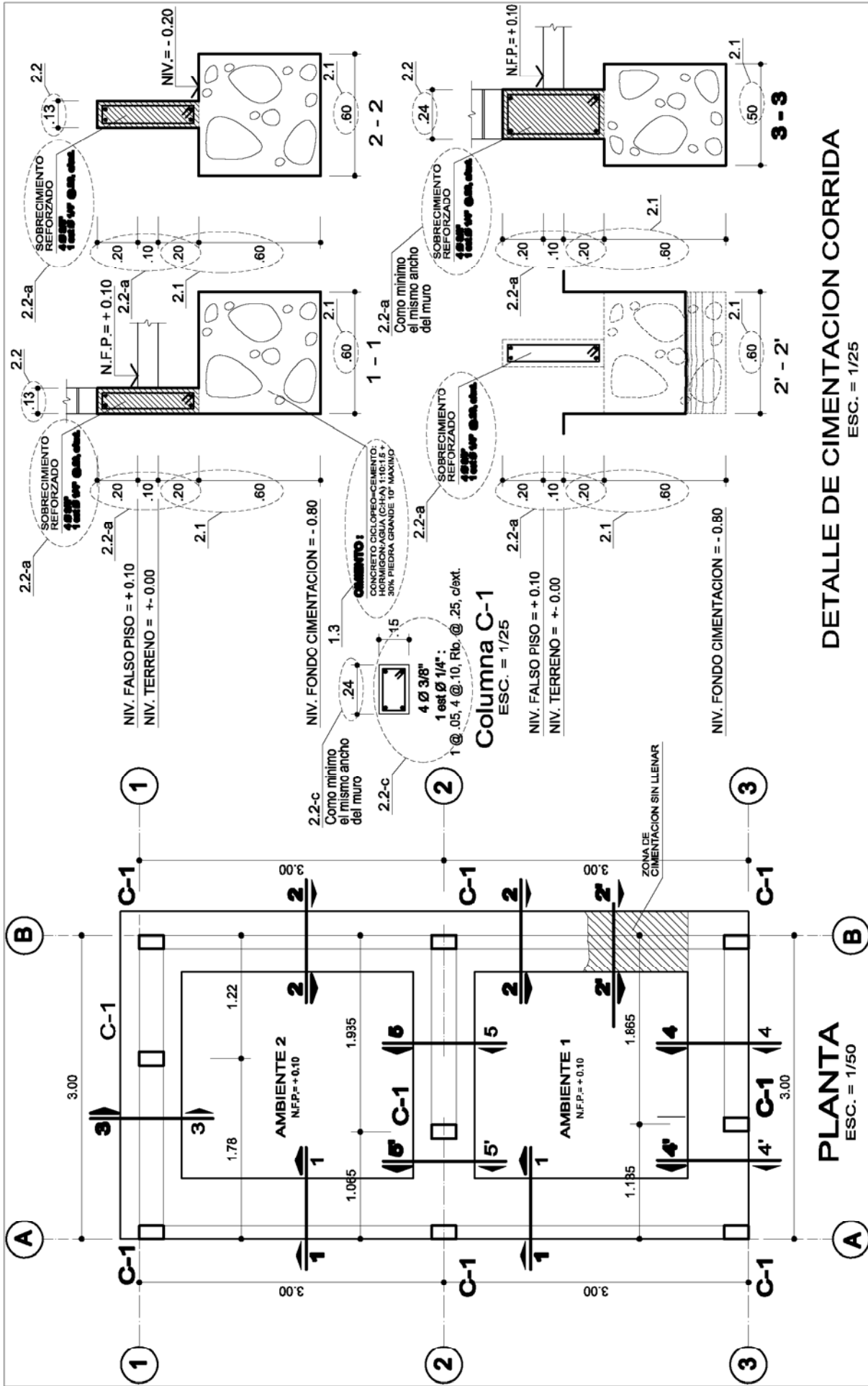


Concientización Acerca de Viviendas Seguras (Proyecto Piloto N° 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú	
JICA STUDY TEAM	LAMINA N° : 06
NOMBRE DE LAMINA : ELEVACIONES	



Concientización Acerca de Viviendas Seguras (Proyecto Piloto N° 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú

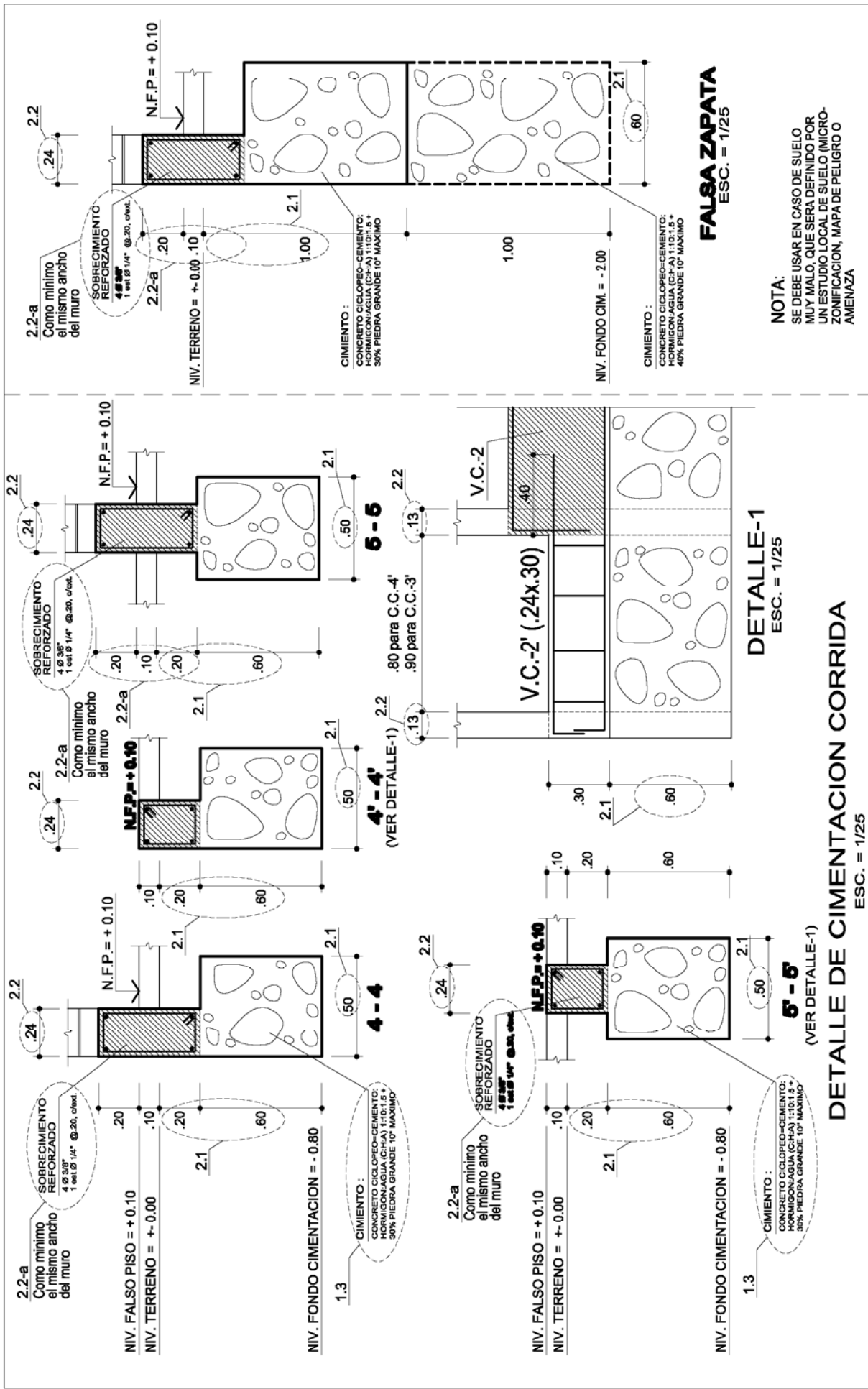
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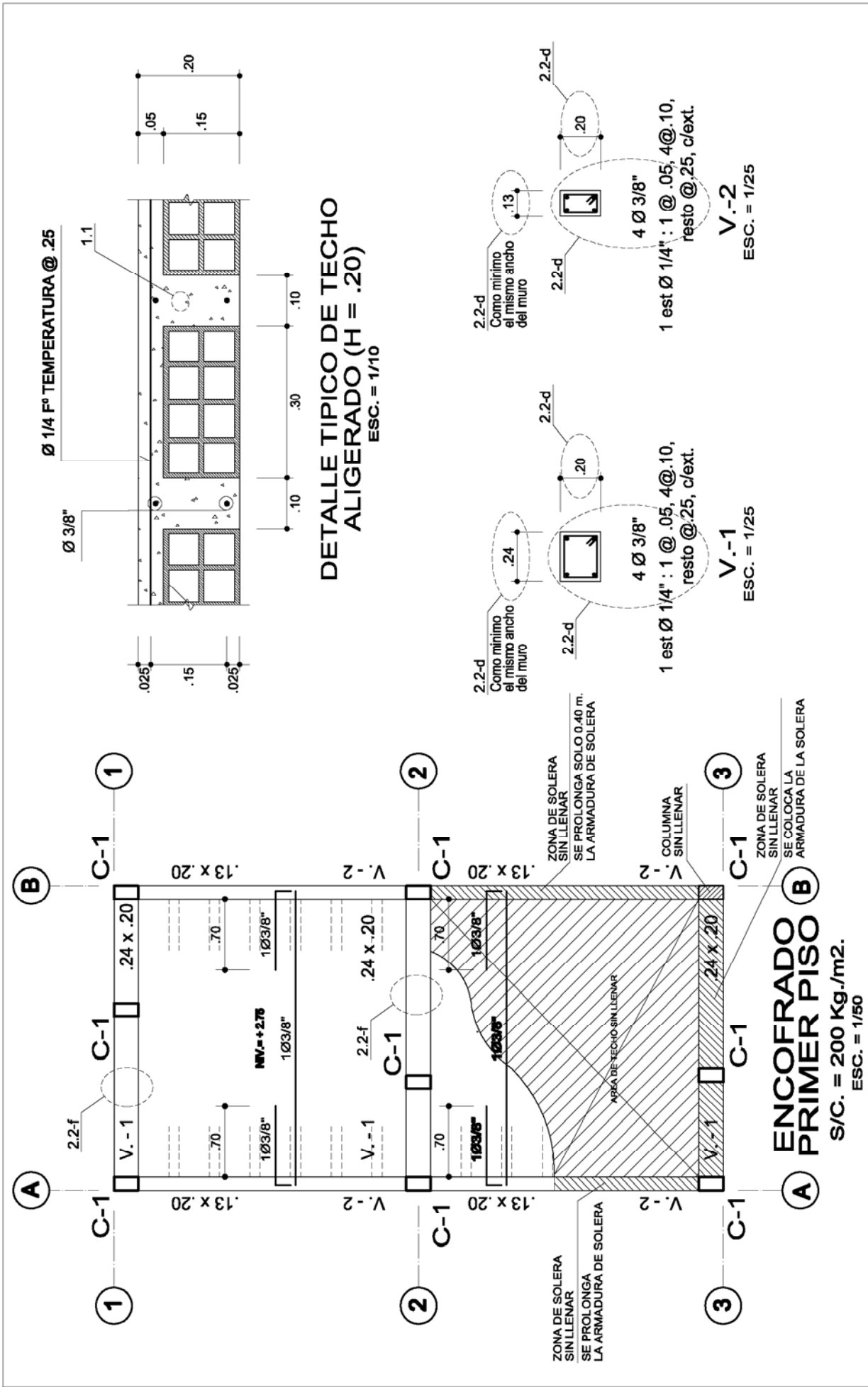
DETALLE DE CIMENTACION CORRIDA
 ESC. = 1/25

PLANTA
 ESC. = 1/50

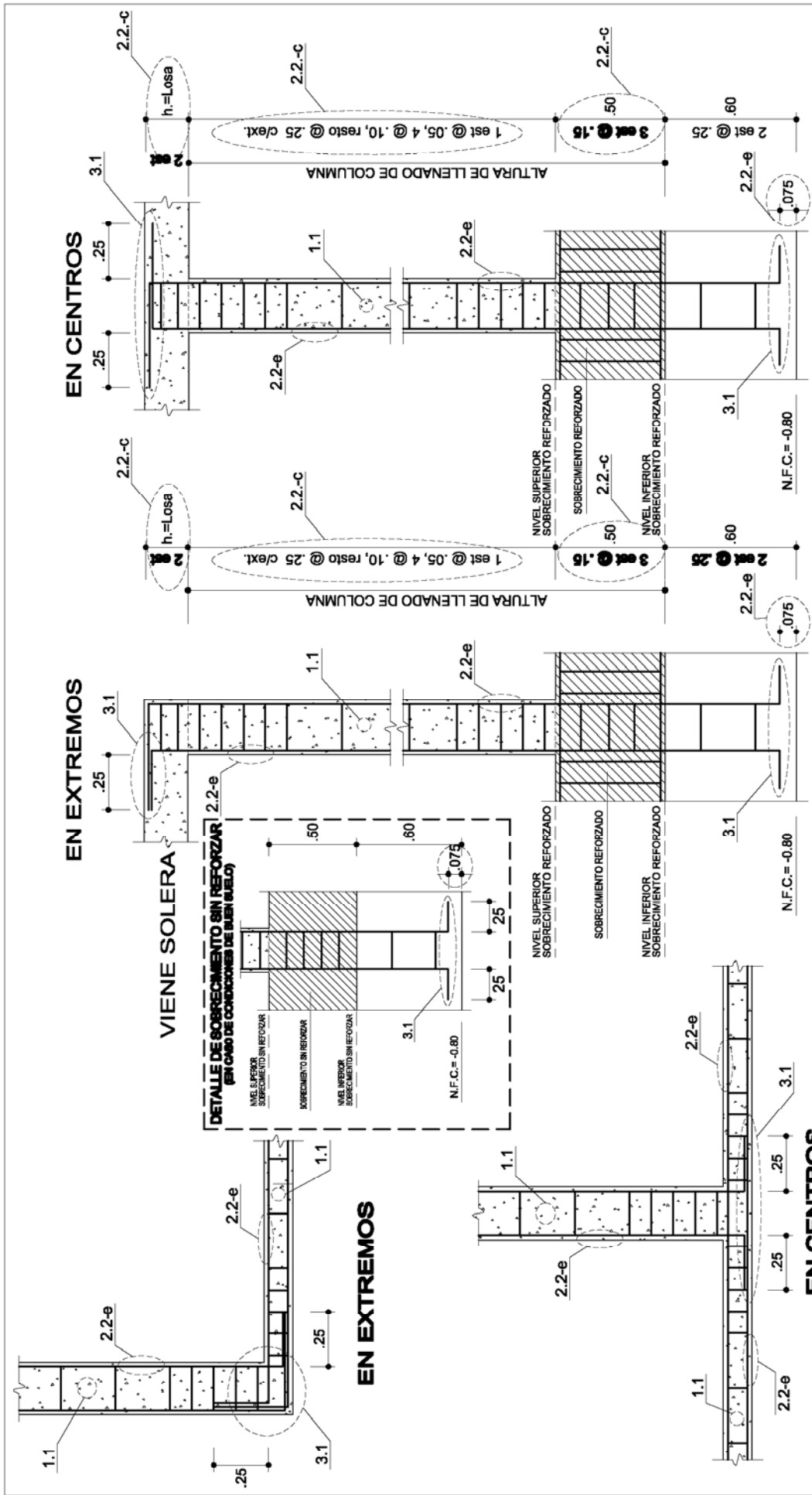
Concientización Acerca de Viviendas Seguras (Proyecto Piloto N° 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú	
JICA STUDY TEAM	LAMINA N°: 08
NOMBRE DE LAMINA:	CIMENTACION, DETALLES



Concientización Acerca de Viviendas Seguras (Proyecto Piloto Nº 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú		
JICA STUDY TEAM	LAMINA Nº: 09	NOMBRE DE LAMINA: DETALLES DE CIMENTACION



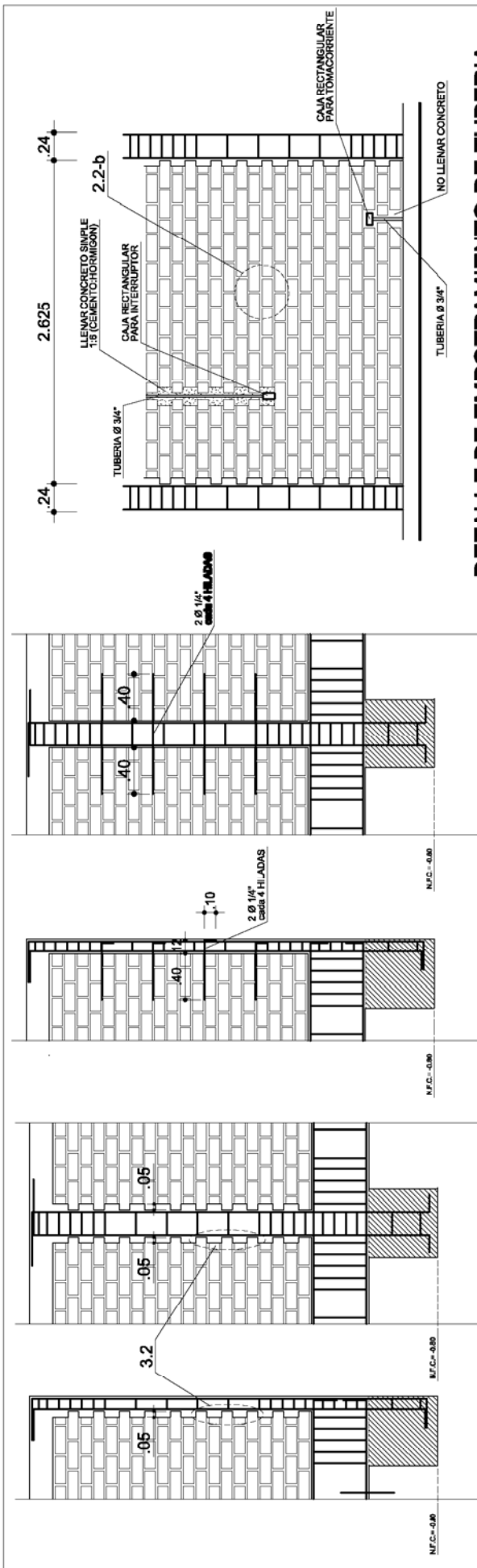
Concientización Acerca de Viviendas Seguras (Proyecto Piloto N° 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú			
JICA STUDY TEAM	LAMINA N° : 10	NOMBRE DE LAMINA :	ENCOFRADO TECHO, DETALLES



DETALLE EN PLANTA DE ANCLAJES DE ARMADURAS EN SOLERAS
ESC. = 1/25

DETALLE DE COLUMNAS DE CONFINAMIENTO
ESC. = 1/25

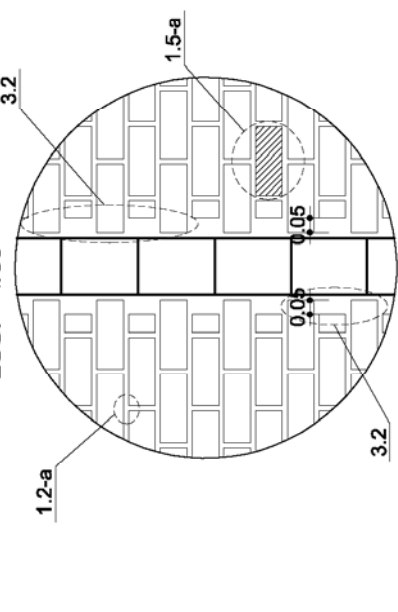
Concientización Acerca de Viviendas Seguras (Proyecto Piloto Nº 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú	
JICA STUDY TEAM	LAMINA Nº: 11
NOMBRE DE LAMINA: DETALLES COLUMNAS Y ENCUENTROS	



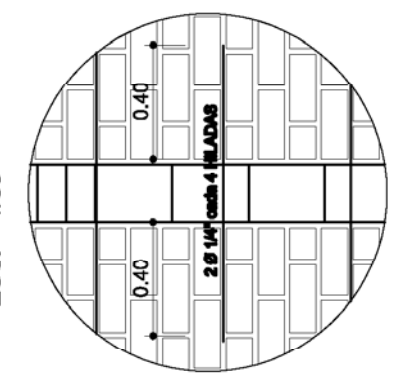
DETALLE DE CONEXION DENTADA COLUMNA-ALBAÑILERIA OPCION-1
 ESC. = 1/50

DETALLE DE CONEXION A RAS COLUMNA-ALBAÑILERIA OPCION-2
 ESC. = 1/50

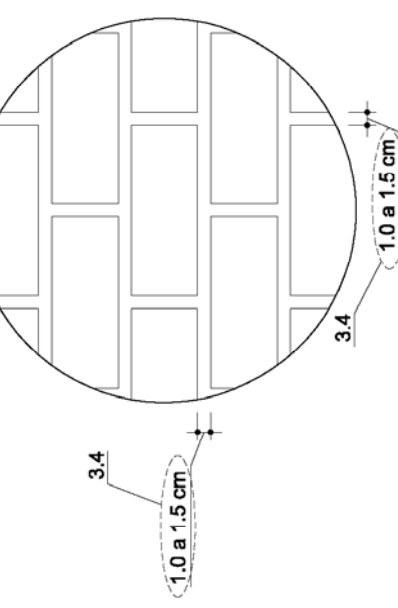
DETALLE DE EMPOTRAMIENTO DE TUBERIA DE INSTALACIONES ELECTRICAS
 ESC. = 1/50



DETALLE DE CONEXION DENTADA COLUMNA-ALBAÑILERIA
 ESC. = 1/25



DETALLE DE CONEXION A RAS COLUMNA-ALBAÑILERIA
 ESC. = 1/25



ESPOSOR DE JUNTA DE MORTERO PARA ALBAÑILERIA
 ESC. = 1/10

Concientización Acerca de Viviendas Seguras (Proyecto Piloto N° 2.1) Para el Estudio de Reconstrucción con Viviendas Sismorresistentes en la República del Perú			
JICA STUDY TEAM	LAMINA N°: 12	NOMBRE DE LAMINA: DETALLES DE ALBAÑILERIA CONFINADA	

ESPECIFICACIONES TECNICAS DE LOS MATERIALES

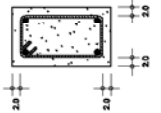
ACERO DE REFUERZO
 LAS VARILLAS DE ACERO UTILIZADAS EN LA CONSTRUCCION DE ESTRUCTURAS DE ALBANILERIA, CUMPLARAN LOS REQUISITOS ESTABLECIDOS EN LOS CAPTULOS 7 Y 8 DE LA NORMA E-060 PARA CONCRETO ARMADO.
 EL ACERO SERA DE CALIDAD, GRADO 60, CON UN ESFUERZO EN EL LIMITE DE FLUENCIA DE $f_y=4200 \text{ kg/cm}^2$.
 CORRUGACIONES DE DOBLADO A LA NORMA ASTM A-615
 DIAMETROS MINIMOS DE DOBLADO SIN FISURAS:
 60b $\phi \ 3/8"$ o $05/8"$
 40b $\phi \ 3/4"$ Y MAYORES
 DEBERA OBSERVARSE QUE LAS VARILLAS A EMPLEAR PRESENTEN SU SUPERFICIE LIBRE DE CORROSION, GRIETAS, SOLDADURAS U OTRO DEFECTO.

COLOCACION DEL REFUERZO:
PREPARACION Y COLOCACION:
 ANTES DEL EMPLEO DE LAS VARILLAS SE LIMPIARAN CUIDADOSAMENTE PARA QUE SE ENCUENTREN LIBRES DE POLVO, BARRO, ACEITES, PINTURA Y TODA OTRA SUSTANCIA CAPAZ DE REDUCIR LA ADHERENCIA CON EL CONCRETO.
 PARA SOSTENER O FLUAR LAS VARILLAS EN LOS LUGARES CORRESPONDIENTES SE EMPLEARAN SOPORTES O ESPACIADORES METALICOS O DE MORTERO Y ATAQUAS METALICAS, NO PODRAN UTILIZARSE TROZOS DE LADRILLO, MAQUERA O CAÑAS, NI PARTICULAS DE AGREGADOS.

RECURRIMIENTOS DEL REFUERZO:
 SE EXTENDE POR RECURRIMIENTOS A LA DISTANCIA LIBRE COMPRENDIDA ENTRE EL PUNTO MAS SALIENTE DE CUALQUIER REFUERZO Y LA SUPERFICIE EXTERNA DEL CONCRETO MAS PROXIMO, EXCLUYENDO TARRAJES U OTRO MATERIAL DE ACABADOS.

DIMENSIONES DE LOS RECURRIMIENTOS:
ELEMENTO ESTRUCTURAL
RECURRIMIENTO
 - SOLERAS Y COLUMNAS DE ALBANILERIA (TARRAJEADO) 2.0 cm.
 - SOLERAS Y COLUMNAS DE ALBANILERIA (CARAVISTA) 3.0 cm.
 - CIMIENTOS CORRIDOS 7.5 cm.
 CUANDO SEA NECESARIO LOS RECURRIMIENTOS SE LOGRARAN MEDIANTE EL EMPLEO DE DAOS DE CONCRETO Y MORTERO.

RECURRIMIENTO EN SOLERAS Y COLUMNAS



SEPARACION ENTRE VARILLAS

LA SEPARACION MINIMA ENTRE VARILLAS RECTAS INDIVIDUALES Y PARALELAS DE LA ARMADURA, FUERA DE UNA ZONA DE EMPALME, EN GENERAL DEBERA SER COMO MINIMO 2.50 cm. Y NO MENOR QUE EL TAMAÑO MAXIMO DE AREGADO GRUESO.

CONCRETO
 CONCRETO SIMPLE
 -Cimiento: 1:10:1.5 (CEMENTO : HORMIGON : AGUA) + 30% PM 10" MAX.
 CONCRETO ARMADO
 -Sobrecimiento reforzado: 1:2:4:1 (CEMENTO : ARENA GRUESA : PIEDRA CHANCADA 1/2" : AGUA)
 -Columnas de confinamiento, vigas soleras, losa aligerada. 1:2:3:1 (CEMENTO : ARENA GRUESA : PIEDRA CHANCADA 1/2" : AGUA)
ALBANILERIA
 - Los ladrillos deberan estar libres de polvo, sin grietas ni abobes.
ACERO
 -Esfuerzo fluencia $f_y = 4,200 \text{ kg/cm}^2$
 LONGITUD DE ANCLAJE 36 DIAMETROS
MORTERO
 Mortero adherido, trabajable, retentivo y fluido (ca=1:4) cemento tipo I, II y IP

CRITERIOS DE DISEÑO ESTRUCTURAL
A. CODIGOS DE STANDARES UTILIZADOS
 1.00 CODIGOS UTILIZADOS
 NORMA E-020 (cargas)
 NORMA E-030 (diseño sismoresistente)
 NORMA E-060 (concreto armado)
 NORMA E-070 (albanileria)
2.00 REGLAMENTO
 Reglamento Nacional de Edificaciones
B. CARGAS DE DISEÑO
 2.00 sobrecarga viva (techo) máxima 200 kg/cm2
 3.00 peso propio de aligerado 300 kg/cm2
C. CIENTIFICACIONES
 CIENTIFICACION TIPO CIMENTO CORRIDO
 a. β : máxima asumido 0.90 kg/cm2
 b. profundidad de cimentación adoptada 0.80 m. min.

TRASLAPES Y EMPALMES		ESTRIBOS	
LOSAS VIGAS (cm)	COLUMN. (cm)	LOSAS Y SOLERAS	COLUMNAS
ϕ 6mm	30		
9mm 3/8"	40	NO SE PERMITIRAN EMPALMES DEL REFUERZO SUPERIOR (NEGATIVO) EN UNA LONGITUD DE 1/4 DE LA LUZ DE LOSA O VIGA A CADA LADO DE LA COLUMNA O APÓYTO.	LOS EMPALMES "L" SE UBICARÁN EN EL TERCIO CENTRAL, NO SE EMPALMARÁN MÁS DEL 50% DE LA ARMADURA EN UNA MISMA SECCIÓN.
1/2"	60		
5/8"	80	ϕ	L Rmbx
3/4"	70		
1"	120	10cm	15cm
		3/8"	2cm

CUADRO DE GANCHOS STANDARD EN VARILLAS DE ACERO CORRUGADAS PARA VIGUETAS

NOTA:
 EL ACERO DE REFUERZO UTILIZADO EN FORMA LONGITUDINAL, EN SOLERAS Y COLUMNAS, DEBERÁN TERMINAR EN GANCHOS STANDARD, LOS CUALES SE ALINEARÁN EN EL CONCRETO CON LAS DIMENSIONES ESPECIFICADAS EN EL CUADRO MOSTRADO.

	ϕ G (cm)
3/8"	20
1/2"	25

PARAMETROS SISMICOS

PARAMETRO	FACTOR
Ponder de Zona	Z = 0.4 g
Categoría	U = 1.0
Tipo de Suelo	S = 1.4
Período de Suelo	Tp = 0.9 s
Coef. de Flexión	R = 6
Coef. Sismático	C = 2.5