

## **Appendix 8**

# **MANUAL OF SIMPLE INSPECTION FOR CONSTRUCTION OF SAFER HOUSING**



PERÚ

Ministerio  
de Vivienda, Construcción  
y Saneamiento

# Manual of Simple Inspection for Construction of Safer Housing

*For the Reconstruction*

September 2008

Japan Internacional  
Cooperation Agency

## **TO READERS OF THIS BOOK**

Big Earthquake was occurred in Ica region on August of 2007 and revealed vulnerability of houses against earthquake. Housing reconstruction needs safer housing against earthquake. Japan International Cooperation Agency (hereinafter referred to as "JICA") has conducted the Study on Housing Reconstruction with Seismic-resistant Houses in the Republic of Peru (hereinafter referred to as "the Study") in response to a request of the Government of the Republic of Peru (hereinafter referred to as "the Government of Peru").

An idea of safer housing is come from concepts of minimum requirements, which illustrate the essence of structural aspects of housing in design, construction and inspection. JICA Study Team has prepared the minimum requirements of safer housing. The minimum requirements are guided by key requirements established in Sub-Project on Housing Administration Capacity Enhancement to improve the vulnerability of Housing for Central Java and DIY Earthquake Reconstruction Program Indonesia which was conducted by JICA.

Based on the minimum requirements, i) prototype drawings for safer housing, ii) manual of watching over construction of safer housing and iii) manual of simple inspection for construction of safer housing were prepared by the Study. Those materials play an important role in facilitating safer housing reconstruction of affected families. Majority of the affected families cannot prepare the necessary drawings for building permit due to a lack of budget. The prototype drawings can be adopted as the necessary drawings. The manual of watching over construction of safer housing can be applicable for house owner to check whether or not house construction is appropriate. Taking user-friendly manual into consideration the manual was prepared for the one who has no construction knowledge to understand appropriate construction methods easily. This book "manual of simple inspection for construction of safer housing" can assist in developing capability of municipal inspectors for safer housing construction. Those two manuals help to complement a lack of municipality inspectors.

Existing building permit itself needs speedup and simplification due to lots of applicants who reconstruct their houses without delay. For that reason JICA Study Team has proposed to introduce the prototype drawings and the above-mentioned manuals into the existing building permit system.

District municipality will have a drawing bank for building permit by making use of the prototype drawings. The drawing bank benefits building permit applicants because the prototype drawings show affordable construction costs and are automatically approved in a process of building permit. Construction of safer housing will be disseminated through activities based on the said manuals. In other words, the house construction will be watched over carefully by house owner and inspected exactly by municipality inspector.

The readers of this book are government officials of district municipalities. This book will be used for textbook of on-the-job training for the government officials.

Chapter I provide the readers with necessary knowledge of simple inspection. The necessary knowledge consists of technical and administrative aspects. Selected fifty (50) technical terms are introduced to allow a smooth communication between inspectors and construction laborers. The heart of the book, i.e., what is a simple inspection is illustrated. It is disclosed which level of technical capability is needed as municipal inspectors, taking into consideration actual availability of personnel in district municipalities.

Chapter II shows a practical procedure of the simple inspection. It shows how to use this book. In the preparation stage, there are some tasks such as training, collection of documents and scheduling of implementation. In the implementation stage, the points are provided in order to get enough understanding of simple inspection. The implementation stage is divided into four (4) from the beginning of construction to the completion of construction. In each stage, the followings matters are explicated; timing, targets to be inspected, evaluation and suggestion and recording.

In order to make full use of this book in the administration scene, the forms and publicity fliers are included in the appendices.

Hopefully, this book contributes to housing reconstruction in Ica region.

Dr. Sugiyama Kyoichi  
Expert of seismic resistant structure, JICA Study Team

The following members of JICA Study Team are the writers of this book.

Kobayashi Ichiro, Leader  
Sugiyama Kyoichi, Expert of Seismic Resistant Structure  
Iván Alonso Zapata Rojas, Structural Engineer  
Hernán Oscar Zapata Rojas, Document Specialist  
Jhon Urdanegui Urdanegui, Civil Engineer  
Joan Willy Hugo Guardia, Structural Engineer  
Cesar Enrique Diaz Munoz, CAD Operator

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## **ACKNOWLEDGEMENTS**

This book was prepared by JICA Study Team, thanks to the united efforts of Ministry of Housing, Construction and Sanitation (hereinafter referred to as "MVCS") which is implemented the Study jointly.

Dr. RF Romulo Triveño Pinto, president of Ica Region, has made district municipalities in Ica Region a request of cooperation with JICA Study Team as smooth implementation of the Study.

Mayors of the target district municipalities, where a pilot project of the Study is implemented, provides officials and place for on-the-job training of the Study to deal with needs from many people to reconstruct their houses. The mayors are; Mr. Lucio Juarez Ochoa of Pueblo Nuevo in Chincha province, Mr. Mariano Ucharima of Independencia in Pisco province and Dr. Ruben A. Velázquez Serna of La Tinguiña in Ica province.

Dr. Carlos Alberto Zavala Toledo, a director of CISMID (Centro Peruano-Japones de Investigaciones Sismicas y Mitigacion de Desastres) and an associate professor of FIC/UNI (Facultad de Ingenieria Civil, Universidad Nacional de Ingenieria), has become a technical advisor of the pilot project of the Study to have given many practical and professional advices to JICA Study Team. He authorized the minimum requirements in respect of civil engineering.

Lastly, I highly appreciate efforts of some other persons concerned with the Study.

Eng. Kobayashi Ichiro  
JICA Study Team Leader

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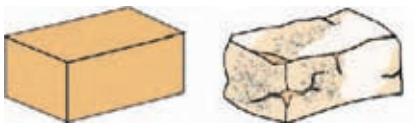



# CHAPTER I: NECESSARY KNOWLEDGE FOR SIMPLE INSPECTION IN THE CONSTRUCTION OF SAFER HOUSING

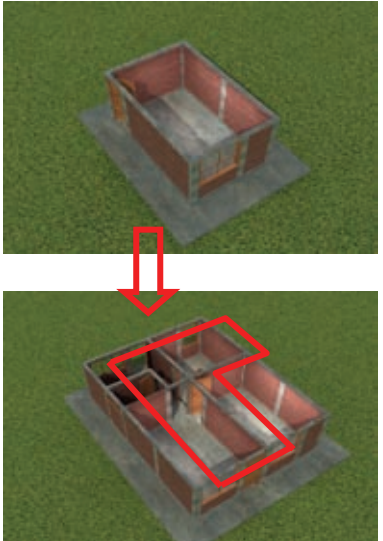
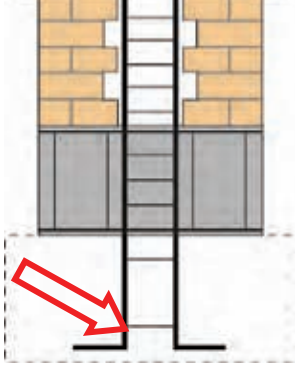


## 1.1 TECHNICAL TERMS OF SIMPLE INSPECTION



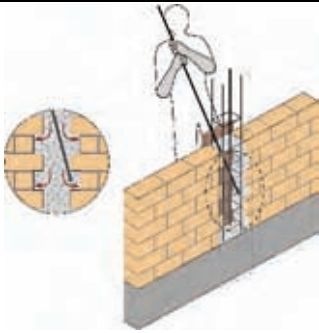


### (1) List of technical terms for the Simple Inspection of Safer Housing





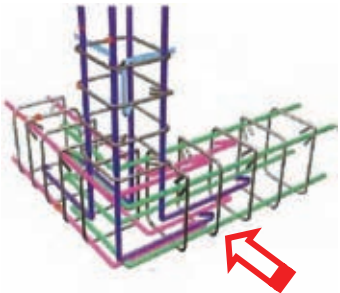
**Table 1.1 List of Technical Terms**

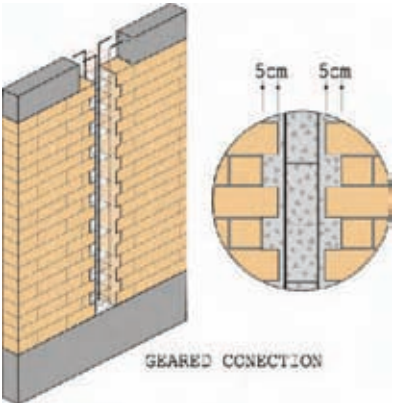
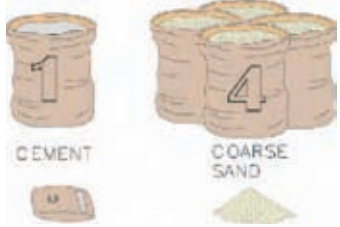

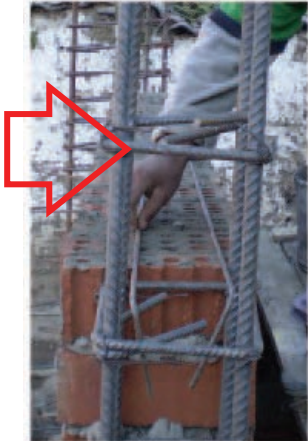
ITEM	TERM	DEFINITION	ILLUSTRATION
1	<b>Aggregate</b>	Granular material of natural or artificial nature such as gravel, sand, crushed stone, used in the preparation of concrete or hydraulic mortar.	
		National Regulation of Construction	
2	<b>Warp</b>	Deformation on one of the sides of a body or surface. <i>Deformed brick cannot be used in construction</i>	
		Microsoft® Encarta® 2008	
3	<b>Confined masonry</b>	Reinforced masonry with elements of reinforced concrete poured in all perimeter. <i>Walls tied to beams and columns</i>	
		National Regulation of Construction	





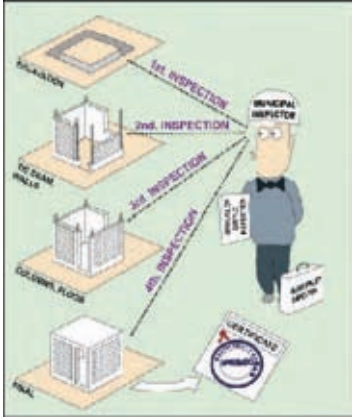
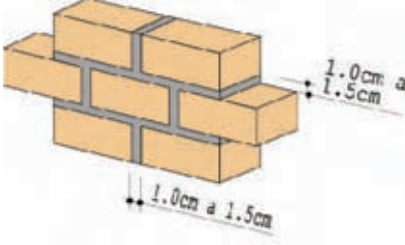
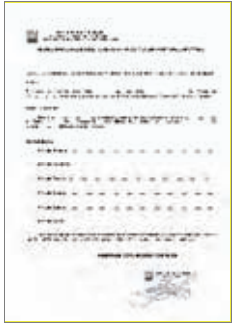
<p>4</p>	<p><b>Expansion</b></p>	<p>Work conducted from an preexistent building, increasing the roofed area.</p>	
<p>National Regulation of Construction</p>			
<p>5</p>	<p><b>Anchor</b></p>	<p>To fasten firmly, to support the steel of the beams to the foundation</p>	
<p>Microsoft® Encarta® 2008</p>			
<p>6</p>	<p><b>Sand</b></p>	<p>Fine aggregate, coming from the natural disintegration of rocks, composed by fine particles</p>	
<p>National Regulation of Construction</p>			
<p>7</p>	<p><b>Stirrup</b></p>	<p>Tying element to impede the structure deformation</p>	





8	<b>Auto-construction</b>	Progressive and planned construction modality, executed directly under the owner's responsibility and with municipality technical supervision	
Law 27157			
9	<b>Honeycomb</b>	Void spaces in the structural members of concrete due to the deficiencies in the concrete die cast	
10	<b>To stir (Chusear).</b>	Stirring of the concrete mix with a stick to avoid honeycombs	
11	<b>Foundation</b>	Underground of the house, supports the entire weight of the same	
12	<b>Reinforced Beam</b>	Element of reinforced concrete designed and constructed to transmit horizontal and vertical load to the foundation. Columns can function simultaneously as stirrup or confinement.	






		National Regulation of Construction	
13	<b>Concrete</b>	Mixture of Portland cement or any other hydraulic cement, aggregates and water with or without additives	
		National Regulation of Construction	
14	<b>Reinforced Concrete</b>	Concrete reinforced with steel	
15	<b>Cyclopean concrete</b>	Plain concrete with the addition of huge stones	
		National Regulation of Construction	
16	<b>Plain concrete</b>	Concrete without reinforcement armor or with less than the specifications for reinforced concrete	
		National Regulation of Construction	
17	<b>Connection</b>	To link, bond one thing to another; union where two structural members are joined	
		Microsoft® Encarta® 2008	





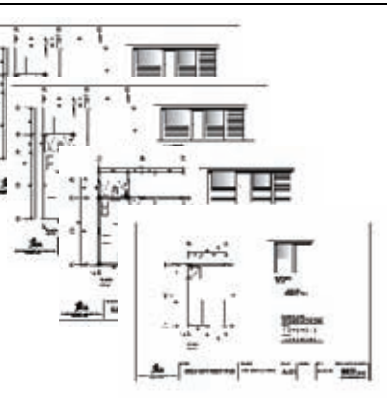
18	<b>Confinement</b>	Set of reinforced concrete elements, horizontal and vertical, which functions are to provide ductility to a bearing wall. Perimeter wall binding.	
19	<b>Constructor</b>	Person whose responsibility is to execute the work  National Regulation of Construction	
20	<b>Dosing</b>	Regulation of quantities to mix in order to get a good concrete.	
21	<b>Framing</b>	System of temporal casts to shape the concrete or other material during the concrete hardening period	
22	<b>Stirrup (Estribo)</b>	Elements that fix the beam and column steel to avoid the deformation of these elements	



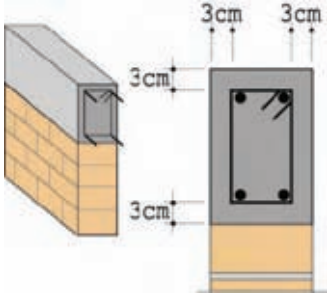


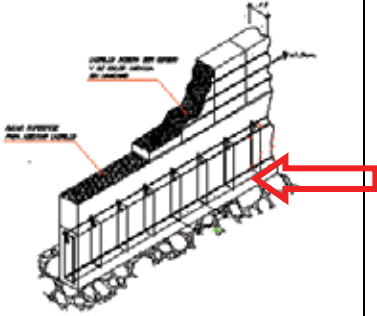

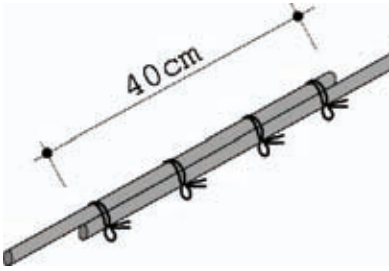
23	<b>Front</b>	Exterior parameter of a building. It can be frontal, sided or posterior.	
National Regulation of Construction			
24	<b>Hormigón</b>	Material containing gravel and sand in the natural form of extraction	
National Regulation of Construction			
25	<b>Simple inspection</b>	Easy, fast and efficient way to conduct the construction inspection using the inspection manual	
26	<b>Inspector</b>	Technical personnel related to construction; verifies the fulfillment of minimum requirements and the prototype drawings	
27	<b>Mortar joint</b>	Space between bricks, 1 a 1.5 cm. thickness with a mixture of cement and sand, to join bricks.	
28	<b>Building permit</b>	Authorization document issued by the municipality to start any kind of construction work	
National Regulation of Construction			



29	<b>Check list</b>	Document to make the verification task of the inspector easier, faster, and safer	
30	<b>Light slab</b>	Element of reinforced concrete with bricks, serves as roofing	
31	<b>Manual of Watching over Construction of Safer Housings</b>	Manual containing the information necessary for the owner to watch over the construction of a safer housing easily and faster.	
32	<b>Manual of simple inspection</b>	Manual containing the information necessary for the municipality inspector to conduct her/his job efficiently.	

33	<b>Fastening and expansions anchor</b>	Element anchored to beams and/or columns for structure connection in case of future expansions.	
34	<b>Mixture</b>	Incorporation of materials to obtain workable mix	
35	<b>Cement mortar</b>	Mixture constituted by cement, predominantly fine aggregate and water  National Regulation of Construction	
36	<b>Apparent brick walls</b>	Walls worked with bricks of smooth, regular surface	
37	<b>Walls without threading</b>	Clay brick walls without mortar coating.	

38	<b>Threaded Walls</b>	Walls with a mortar coating 2 to 3 cm thick	
39	<b>Grinded or crushed stone</b>	Coarse aggregate, obtained by the artificial grinding of rocks or gravel	
National Regulation of Construction			
40	<b>Big Stone</b>	Stones of 10 inches or more of diameter, according to the experience	
41	<b>Medium stone</b>	Stones between 6 and 8 inches of diameter, according to the experience.	
42	<b>Prototype drawings</b>	Drawing of several typical safer houses in confined masonry, based on the minimum requirements	



43	<b>Coating</b>	Concrete that covers the metallic armor of beams and columns	
44	<b>Minimum requirements</b>	Technical guidelines to describe the correct constructive procedures for safer housing	
45	<b>Tie beam</b>	Structure of concrete over the foundation, insulating the brick wall from the soil	
46	<b>Reinforced tie beam</b>	Reinforced concrete structure proposed accordingly to the soil resilience.	
47	<b>Threading</b>	Concrete mortar coating for walls, beams and columns	
48	<b>Overlapping</b>	Minimum size of still to be overlapped to assure the good functioning	
		Microsoft® Encarta® 2008	

49	<b>Beam</b>	Structural element basically works horizontally, supporting the roof	
		National Regulation of ConstructionS	
50	<b>Ring beam.</b>	Reinforced concrete beam poured on a masonry wall to provide anchorage and confinement.	
		National Regulation of Construction	

Source) Study on Housing Reconstruction with Seismic-Resistant House in the Republic of Peru, conducted by JICA Study Team

## 1.2 Simple Inspection for Construction of Safer Housing

### (1) Definition of Simple Inspection

Simple Inspection is a process of verifying the construction of safer housing; this process allows municipalities to assure a correct execution of works, respecting the minimum requirements; such inspection will be conducted by professionals or technical personnel with knowledge in construction works, authorized by the municipalities.

### (2) Difference with a Regular Inspection

The main difference between the simple and regular inspections is the employed methodology. In the simple inspection a municipality inspector can be guided by the description of each activity or work as well as the attached illustration shown on the inspection check list, so that the inspector easily understands the items to inspect at the proper timing in order to properly correct the mistakes at the works.

On the other hand, regular inspection is directed to the inspection of all type of works without reducing the inspector's load. As inspectors do not count on with a simple checklist, they have to consider many standards such as the National Regulation of Construction, legislation in force, safety regulations, quality of specific materials, and so on, during the inspection.

### (3) Implementation of Simple Inspection

Simple Inspection will be conducted by using the check list based on the minimum requirements of safer housing. For this, by making full use of the check list proper inspection can be assured. The followings are to keep carefully when the inspector uses the check list. (See appendix 1- Simple Inspection Check list)

- Activities or works to execute will be read
- Description of the activity or work to inspect will be read
- Minimum requirements related to the work will be recognized
- Attached illustration to identify inspection activity will be used while conducting inspection
- Marking the inspection result, if satisfactory or not, in the box shall be made
- Observations shall be put, if necessary

**Table 1.2 Items of Simple Inspection Check List**

ACTIVITY	DESCRIPTION	MINIMUM REQUIREMENT	ILLUSTRATION	SATISFACTORY	NOT SATISFACTORY	OBSERVATION
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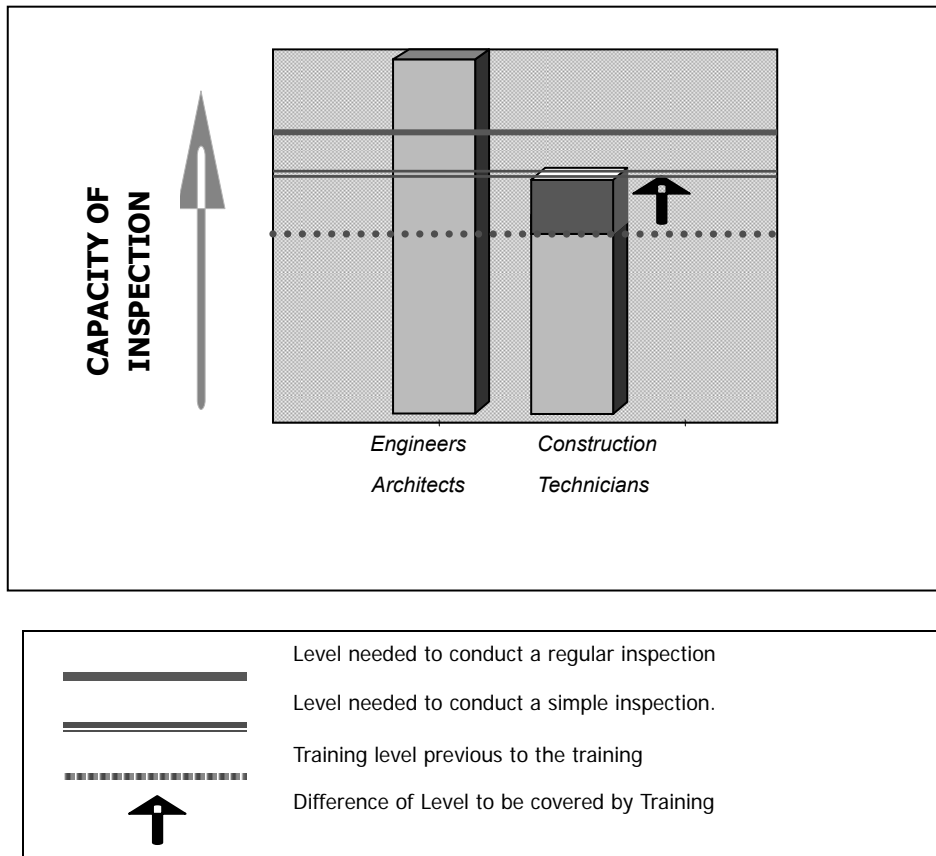
Source) The Study on Housing Reconstruction with Seismic-Resistant Housings in the Republic of Peru, JICA Study Team

### 1.3 Personnel Required for the Tasks

#### (1) Required knowledge and capacities from the municipality inspectors

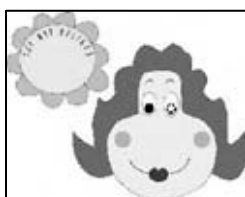
JICA Study Team will train the municipality professionals so that they will be able to train the technical professionals related to construction, they assign as municipality inspectors, with a proper application of the manual and the check list.

It would be better to work with engineers, architects and professionals assigned in the public works department of the municipality. The professionals have the capacity to distinguish and apply the simple inspection manual; Municipality officers of other areas will be trained, to improve their capacities and so conduct inspections in an efficient manner.



**Figure 1.1 Chart of Capacities**

Source) The Study on Housing Reconstruction with Seismic-Resistant in the Republic of Peru Conducted by JICA Study Team

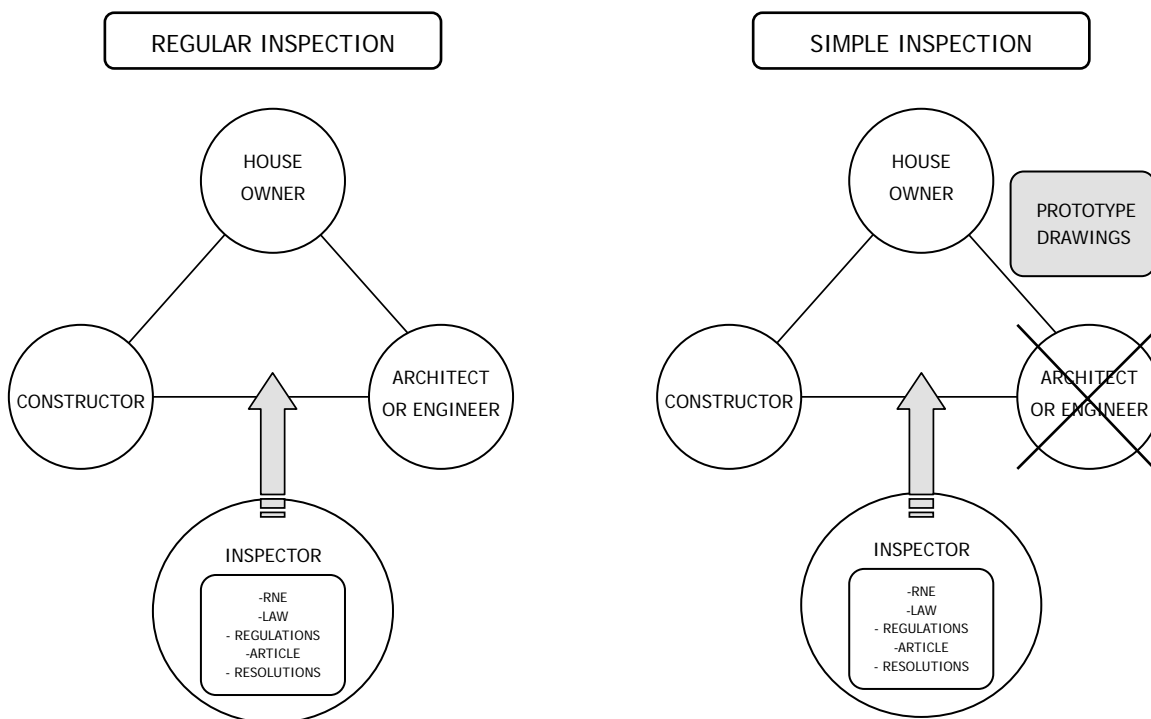


## CHAPTER II: MANUAL FOR THE SIMPLE INSPECTION FOR CONSTRUCTION OF SAFER HOUSING

### 2.1 Use of this manual

It is important to understand that in order to get a safer housing it is necessary to fulfill the minimum requirements in the construction.

In order to complement this point, the participation of the municipality inspector is needed to verify periodically the proper execution of works and the fulfillment of the established regulations.



**Figure 2.1 Comparative Schemes between the Regular Inspection Procedure and the Simple Inspection Procedure**

Source) The Study on Housing Reconstruction with Seismic-Resistant Housings in the Republic of Peru, JICA Study Team

The municipality inspector plays a very important role in the construction of a safer house. The manual of simple inspection for construction of safer housing helps to facilitate the work of the inspector and shows how to inspect a construction simply and easily.

*Do not forget that it is important to consult this manual before the inspection.*

## 2.2 Preparing the Simple Inspection

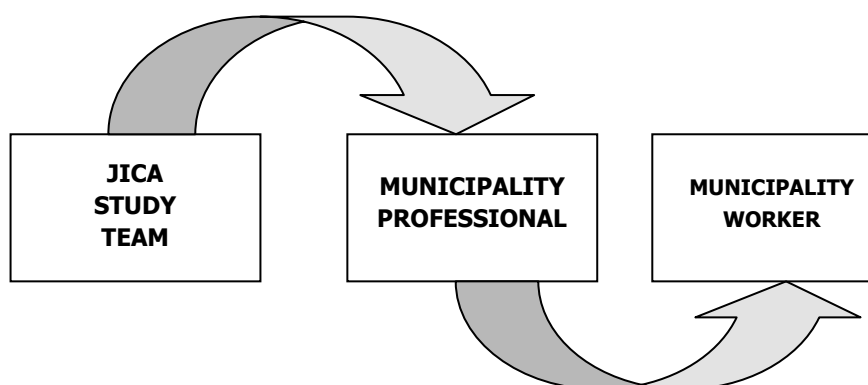
### 2.2.1 Training of the Municipality Inspector

#### (1) Necessity of Training

Training is needed to reinforce and complement the basic knowledge of the municipality inspector, referring to the inspection of the house constructed by the design indicated on the prototype drawings. Once the training is completed, the trainee will get the knowledge needed to use it in an effective manner. Consequently, two important objectives will be attained such as the increase of inspection capacity and the increase in the number of municipality workers prepared for the inspection.

#### (2) Trainer and Trainee

On-the-Job training is planned to be carried out by JICA study team, who prepared this manual. JICA study team will train the professional personnel of the municipalities to improve the capability of tasks of a municipality inspector. The trained professional personnel will proceed to train the other municipality workers to increase the number of the municipality inspector, as required.



**Figure 2.2 Training Scheme**

Source) The Study on Housing Reconstruction with Seismic-Resistant Housings in the Republic of Peru, JICA Study Team

#### (3) Training period

On the job training conducted by JICA study team to the municipality workers will be conducted in around 40 calendar days.

#### (4) Training Program

Training program consists of the followings.

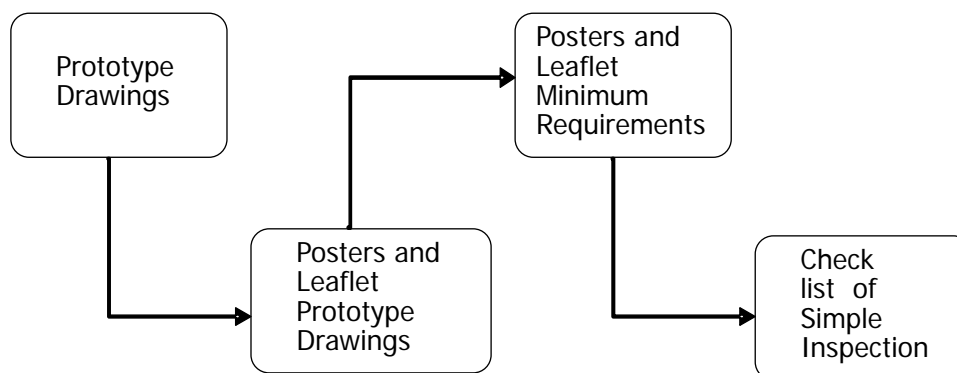
- Technical terms to use in the construction  
(To be familiar with the list of technical words to use in the construction and inspection field – see Table 1.1 – List of Technical Terms).
- Minimum requirements for safer housing  
(To learn to recognize important factors of safer housing such as the quality of materials, structural section of main members, connection of structural members, as indicated in the minimum requirements) See Annex 2
- Application of the minimum requirements  
(To learn to recognize how to apply the minimum requirements into a proper construction procedure of safer housing). See Appendix 3
- Selection of prototype drawings in computer  
(To learn to recognize the basic operation of CAD and selection of prototype drawings). See appendix 4
- Use of the simple check list for construction inspection  
(To learn to recognize the proper application of the check list) See Annex 1
- Practical assistance for the construction inspection  
(To learn to recognize the preparation and arrangement of necessary material for the inspection, and implementation of the inspection and recording of inspection results and observations)

### **2.2.2 Necessary Documents**

#### **(1) List of Necessary Documents**

Following, the necessary documents for the on-the- job training are listed:

- Prototype drawings for safer housing selected by a building permit applicant. See Appendix 4
- Poster of minimum requirements for safer housing. Appendix 3
- Check list of simple inspection for construction of safer housing. See Appendix 1
- Issued building permit application



**Figure 2.3 Schemes of Necessary Documents**

Source) The Study on Housing Reconstruction with Seismic-Resistant Housings in the Republic of Peru, JICA Study Team

## (2) Necessity of Documents

The above-mentioned documents are necessary because as they are all related, they help in the conduction of an efficient inspection. So, prototype drawings show the sections of the housing to be constructed; minimum requirements provide technical support to the structural sections of members in the drawings, so they can be corroborated during the inspection for a safer housing proper construction.

## (3) Use of the documents

For the selection of the appropriate prototype drawing, the matrix for the selection of prototype drawings, based on the applicants conditions and budget (See Appendix 5). Said drawings show the sections of foundation, walls, electric and sanitary installations to be used in the construction of the selected safer housing.

Minimum Requirements poster should be consulted to identify the basic rules to be fulfilled during the inspection activities.

Finally, the check list for simple inspection should also be consulted to verify the activities to be implemented accordingly to the construction procedures. In this manual, said activities are described, together with the respective illustrations, providing so, the necessary knowledge to identify any mistake that might occur during the construction stage.



### 2.2.3 Inspection Schedule

#### (1) Coordinating the Inspection Schedule with the House Owner

This schedule counts on with four inspection stages, the first corresponds to the foundation; the second to the execution of walls, the third to the execution of roofs and the fourth at the construction completion. All of them have established inspection dates, so it will be necessary to establish a date of works commencement in order to follow the established dates.

For the normal fulfillment of the inspection, the house owner has to notify the municipality about the exact date for the construction commencement, said notice will be delivered at the day of the application documents submittal at the municipality; the municipality worker will record in the documents file the commencement day of the works.

(See Annex 7)

#### (2) Reasons for the selection of the inspection dates

These days have been selected in order to be present at the days when the most important and critical tasks of the construction process are executed, and in case of mistakes, corrective measures could be demanded.

That is why the inspector will visit the works in:

- The first inspection, the inspector will be in time to detect any mistake or omission during the execution of the foundation works that is the base of the housing.
- The second inspection, the inspector will be in time to detect any mistake or omission during the execution of the walls, which corresponds to the enclosure of the housing.
- The third inspection, the inspector will be in time to detect any mistake or omission during the roofing works that is the coverage of the housing.
- The fourth inspection, the inspector will be able to verify that the all activities have been executed, always adjusted to the minimum requirements and the prototype drawings.

## 2.3 Implementing Simple Inspection

### 2.3.1 Characteristics of Simple Inspection

#### (1) Most important inspection points

The most important points to be inspected in the visits are:

- At the first inspection; Alignment of the front, outlines, dimensions and materials for cement, dimensions and materials for tie beams.
- At the second inspection; Brick laying, mortar joint thickness, concrete and steel for the columns, concrete and steel for the beam, wall column confinement.
- At the third inspection; Separation between "cañas" (canes) for the roofing, fastening wires, electricity and sanitary installation, so that installations do not cut structures.
- At the fourth inspection; Type of finishing used at the end of the construction, to issue the certificate of construction completion.

**Table 2.1**  
**Relation between Activities and Minimum Requirements**

INSPECTION	ACTIVITIES	MINIMUM REQUIREMENT
FIRST	Facade Alignment	.....
	Outline	.....
	Type of soil	.....
	Foundation depth	Not less than 80 cm
	Foundation width	With load = 60cm/Without load=50cm
	Concrete for foundation	1.10.3 (cement hormigon stone)
	Concrete for tie beam	1.2.3 (cement.sand.stone)
	Steel for tie beam	Steel 3/8" - stirrups 1/4"
SECOND	Concrete for column	1.2.3 (cemen:sand:stone)
	Steel for column	Steel 3/8" - stirrups 1/4"
	Concrete for beam	1.2.3 (cement.sand.stone)
	Steel for beam	Steel 3/8" - stirrups 1/4"
	Dosing for mortar	1.4 (cement.sand)
	Thickness of mortar joint	From 1.0cm. To 1.5 cm
	Brick laying	.....
	Confinment anchoring	Steel 1/4" and 12.5cm inside the column
Confinment jag	Projection not more than 5 cm	
THIRD	Installation in structure section	.....
	Electric installation	.....
	Sanitary installation	.....
	Anchoring for future expansion	.....
	Fastening wire	.....
	Separation between cañas	.....
FOURTH	Culmination of works	.....

Source) The Study on Housing Reconstruction with Seismic-Resistant Housings in the Republic of Peru, JICA Study Team

## **(2) Evaluation of results**

When the construction fulfills the minimum requirements at the simple inspection check list (see Appendix 1), the inspector will mark at the corresponding box "*satisfactory*" or "*unsatisfactory*" when minimum requirements are not fulfilled jeopardizing the quality of the safer housing. In this case, observations will be recorded.

To the owner whose works does not fulfill the minimum requirements and/or the observations of each inspection are not corrected, the rules in force will be applied as required.

## **(3) Dealing with the construction mistakes**

The inspector should know beforehand the activities to inspect and the respective minimum requirements.

The municipality inspector will take notice of the mistake in the observation box at the simple inspection check list; then will communicate the existence of this mistake to the owner and the mason, who should correct it for the next inspection visit, when the inspector of the municipality will certify if it was corrected or not. If it is not corrected, the regulation in force will be applied. (See Appendix 1)

### **2.3.2 Using the Check List.**

#### **(1) Points of the inspection covered by the check list**

Inspector shall consider the relevant activities in the construction process of safer housing. In it, the inspector can see in an organized manner each one of the activities (task) and determine if the execution is in accordance or not with the established minimum requirements.

#### **(2) Filling the check list**

- Identify the activity
- Read the description
- See the illustration
- Relate activity to inspect with the minimum requirement
- Mark the "*satisfactory*" or "*unsatisfactory*" box for the inspected activity.
- Record the pertinent observations.

The correction of the observations recorded in each one of the inspections will be verified in the following inspections.

**(3) Items to inform on the results of the inspection**

- Mistakes in the construction process
- The observations recorded during the inspection
- Correction of the observations

**2.3.3 Detail of the inspections****(1) First Inspection****(a) Inspection timing**

First Inspection can be carried out during days 6th, 7th, 8th or 9th after the start of the works.

(See annex 6)

**(b) Items to inspect**

Tasks related to the execution of foundation and related items are inspected. The inspector will verify, among other things, if the outlines were correctly marked according to the drawings and if the foundation dimensions (width and depth) are in accordance to the established minimum requirements.

(See Annex 2)

**(c) Evaluation**

In order to conduct a proper evaluation the inspector should use the check list for simple inspection. This list allows the inspector to verify in an ordained manner each one of the activities programmed for this stage.

That is:

- The alignment of the front, verifying that the sidewalls, neighboring lots, municipal retreat, etc.
- Outline, verifying that the marks in the land are coincident with the drawings.
- Type of soil, verifying the quality and proportion of the elements found in the land excavation.
- Foundation, verifying the sections according to the drawings and the quality of material used.
- Tie beams, verifying the sections according to the drawings and the quality of material used.

This check list has boxes to be filled accordingly to the execution of tasks, if they are satisfactorily fulfilled or not; besides it allows the inspector to record some observation found at the moment of the inspection.

**(d) Suggestions in case of a mistake**

When a mistake is detected it is suggested to:

- Consult the prototype drawings for safer housing
- Consult the minimum requirements for safer housing
- Take notes of the mistakes in the check list
- Communicate the mistake to the housing owner and to the mason to avoid the repetition of the mistake
- Inform them that the correction of the mistake will be verified in the next inspection visit.
- If the mistake is serious, the correction should be executed in this same visit.

**(e) Inspection record**

Once the inspection is finished, each one of the observations and the fulfillment or not of the minimum requirements will be recorded in the check list, and signed by the house owner and the inspector. This check list will be annexed to the building documents file at the technical office of the municipality.

**(2) Second Inspection**

**(a) Inspection time**

Second Inspection can be carried out during days 19th, 20th, 21st or 22nd after the start of the works.

**(b) Items to inspect**

During the second inspection, tasks related to the execution of walls and related items are inspected. The inspector will verify, among other things, the thickness of the mortar joint in the brick lying, the quality of steel and concrete used in beams and columns and the confinement of the walls with the structures. Also, the inspector will confirm the corrections of observations noted during the First Inspection.

(See Annex 2)

**(c) Evaluation**

Verify in an ordained manner the execution of each one of the activities programmed for this stage. That is :

- Mortar joint thickness should be between 1 and 1.5 centimeters
- Brick lying should maintain the proper verticality and continuity
- Steel sections used in beams and columns should correspond to the drawings indications
- Concrete utilized in the structures should correspond to the adequate dosing of materials in order to obtain the corresponding resistances.
- In the confinement of wall with the structures the inspector should verify if the corresponding anchoring or the 5 centimeter jaggy is set.

In the boxes of the list the satisfaction or not about the executed tasks should be marked. Besides some other observation found during the inspection should also be noted.

**(d) Suggestions in case of a mistake**

- Consult the prototype drawings
- Consult the minimum requirements
- Take notes of mistake in the check list
- Communicate the mistake to the housing owner and to the mason to avoid the repetition of the mistake
- Inform them that the correction of the mistake will be verified in the next inspection visit.
- If the mistake is serious, the correction should be executed in this same visit.

**(e) Inspection record**

Once the inspection is finished, each one of the observations and the fulfillment or not of the minimum requirements will be recorded in the check list, and signed by the house owner and the inspector. This check list will be annexed to the building documents file at the technical office of the municipality.

It should also be registered if the mistakes have been corrected or not, and being the case, the works should be stopped and the correction of the mistakes should be demanded, according to the regulation in force.

**(3) Third Inspection.****(a) Inspection time**

This inspection can be carried out during days 34th, 35th, 36th or 37th after the start of the works.

**(b) Inspection Items**

In the third inspection, the inspector should verify the tasks related to the execution of roofs and/or coverage. Also, the inspector should make sure that the observations noted in the second inspection are corrected.

**(c) Evaluation**

The inspector will evaluate if the owner corrected the mistakes observed in the previous inspections. With the check list, the inspector will verify in an ordained manner, each one of the activities programmed for this stage.

That is:

- Distance between the “cañas” (canes) should be 50 centimeters to each other or as indicated in the drawings.
- Sanitary installations, electricity installations should not cut beams or columns.
- Electric and sanitary installation devices should correspond to the type and model specified in the drawings in order to assure the useful life of the same
- Anchors for future expansion should be recovered with a concrete grout to assure the proper adherence when expansions are carried out.

At the same time, the inspector will fill the boxes of the list according to the satisfaction or not of the executed tasks, besides it allows the inspector to write down some observation found at the moment of the inspection.

**(d) Suggestion in case of a mistake**

When a mistake is detected it is suggested to:

- Consult the prototype drawings
- Consult the minimum requirements
- Take notes of mistake in the check list
- Communicate the mistake to the housing owner and to the mason to avoid the repetition of the mistake
- Inform them that the correction of the mistake will be verified in the next inspection visit.
- If the mistake is serious, the correction should be executed in this same visit.

**(e) Inspection record**

Once the inspection is finished, each one of the observations and the fulfillment or not of the minimum requirements will be recorded in the check

list, and signed by the house owner and the inspector. This check list will be annexed to the building documents file at the technical office of the municipality.

It should also be registered if the mistakes have been corrected or not, and being the case, the works should be stopped and the correction of the mistakes should be demanded, according to the regulation in force.

#### **2.3.4 Fourth Inspection (Final Inspection)**

##### **(1) Time to inspect**

This inspection can be programmed in the day 42th after the commencement of the construction or when it is finished.

##### **(2) Inspection items**

In this Final Inspection, the inspector should verify the finishing and that the construction is according to the drawings and respecting the minimum requirements.

##### **(3) Evaluation**

In order to conduct a proper evaluation the inspector should use the check list and take into consideration the quality of finishing and certify that the works are in accordance to the prototype drawings.

This evaluation will allow the municipality to issue a Work Completion Certificate if the owner so requests.

##### **(4) Suggestions in case of mistake repetition**

When a detected mistake is not corrected it is suggested to:

- If the mistake is not serious, the observation has to be corrected before issuing the certificate.
- If the mistake is serious, procedures will be taken according to the regulation in force.

##### **(5) Inspection record**

Once the inspection is finished, each one of the observations and the fulfillment or not of the minimum requirements will be recorded in the check list, and signed by the house owner and the inspector. This check list will be annexed to the building documents file at the technical office of the municipality.



## **APPENDIX:**

- Appendix 1: Simple Inspection Check List
- Appendix 2: Minimum Requirements for Safer Housing
- Appendix 3: Poster of Minimum Requirements for Safer Housing
- Appendix 4: Pamphlet of Safer Housing Prototype Drawings
- Appendix 5: Matrix for the Selection of Prototype Drawings
- Appendix 6: Schedule of Inspections
- Appendix 7: Flow Chart of the Improved Building Permit System
- Appendix 8: Table of Contents "Manual of Watching Over Safer Housing Construction"




## Appendix 1: Simple Inspection Check List

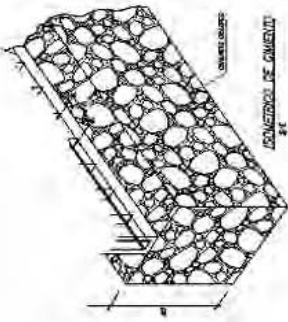
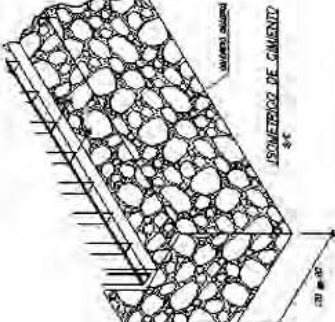
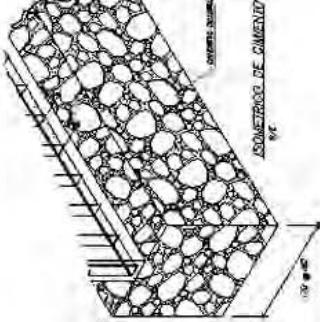
1 <sup>st</sup> REVISION OF DOCUMENTS NEEDED FOR INSPECTION		CHECK LIST FOR INSPECTION					
DOCUMENT	DESCRIPTION	MINIMUM REQUIREMENTS	ILLUSTRATION	No.	SATISFACTORY	UNSATISFACTORY	OBSERVATIONS
TECHNICAL SPECIFICATIONS	DETAIL OF CONSTRUCTION PROCESSES, CHARACTERISTICS OF MATERIALS, ETC.						
LOCATION PLAN	IDENTIFICATION OF AVENUES AND/OR PERIPHERAL ROADS, NEIGHBORING LOTS, ETC.						
ARCHITECTURE DRAWINGS	SIZE OF LOTS, SPACE DISTRIBUTION, HEIGHT AND THICKNESS, FACADE (FRONT) ILLUSTRATION						

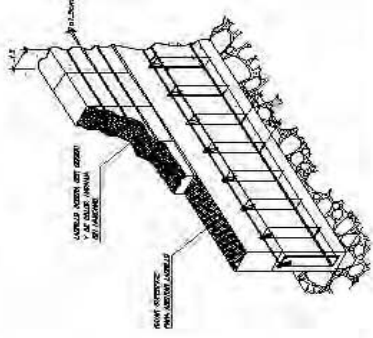
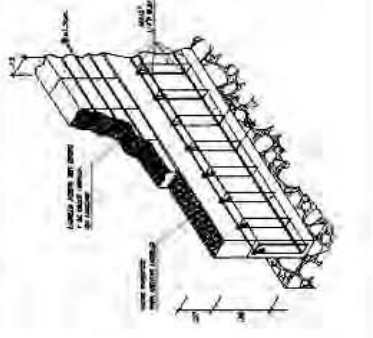




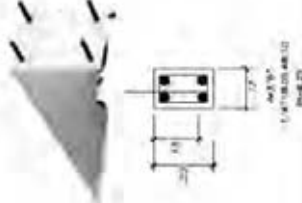
2° WORKS AT THE CONSTRUCTION SITE

2.1.- INSPECTION N° 1

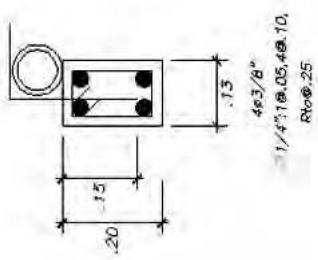
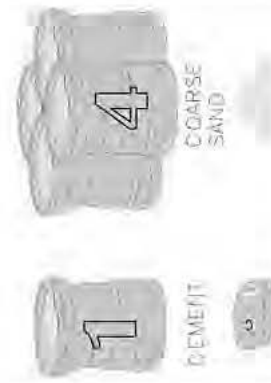
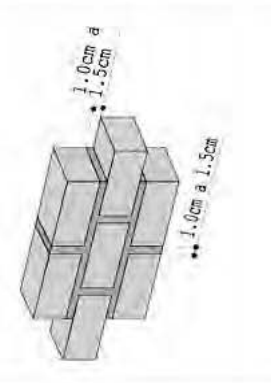
ACTIVITY	DESCRIPTION	MINIMUM REQUIREMENTS	ILLUSTRATION	No.	SATISFACTORY	UNSATISFACTORY	OBSERVACIONES
ALIGNMENT OF THE FRONT	TO RESPECT THE PROPERTY BOUNDARY WITHOUT INVADING SIDEWALKS OR NEIGHBORS. RESPECT THE REGULATED RETREATS			1			
OUTLINE	MARKS WITH PLASTER SHOULD COINCIDE WITH THE DRAWINGS			2			
TYPE OF SOIL	TYPE AND PROPORTION OF MEMBERS FOUND IN THE SOIL EXCAVATION			3			

FOUNDATION DEPTH	VERIFY THAT IT IS AT LEAST 80 CM DEEP	2.1		4		
FOUNDATION WIDTH	VERIFY THAT IT IS AT LEAST 60 CM WIDE	2.1		5		
CYCLOPEAN CONCRETE	DOSING OBTAINED BY MIXING (1:10:3) 1 CEMENT BAG+ 10 HORMIGON BAGS+ 3 LARGE 10" STONE BAGS	1.3 a)		6		

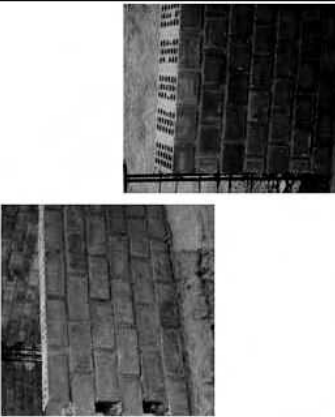
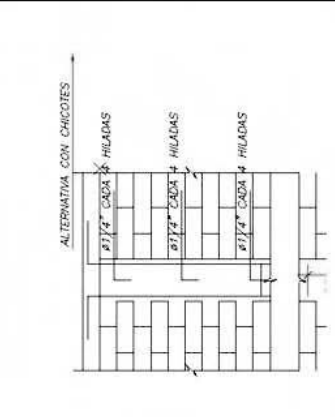
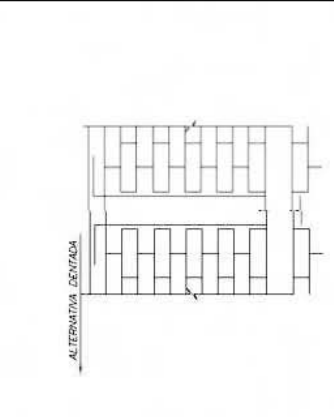
						<p>TIE BEAM: CONCRETE 175KG/CM2</p>
		<p>7</p> 	<p>1.1 - a)</p>	<p>DOSING BY MIXING (1:2:3) 1 CEMENT BAG+ 2 SAND BAGS + 3 BAGS OF CRUSHED STONE + 2 CANS OF WATER</p>		
		<p>8</p> 	<p>2.2 a)</p>	<p>3/8" STILL WITH 1/4" STIRRUPS EACH 20 CM.</p>	<p>TIE BEAM: STEEL DIAMETER</p>	

2.2.- INSPECTION N° 2							
ACTIVITY	DESCRIPTION	MINIMUM REQUIREMENTS	ILLUSTRATION	No.	SATISFACTORY	UNSATISFACTORY	OBSERVACIONES
COLUMN: CONCRETE: 210 KG/CM2	DOSING BY MIXING (1:2:3) 1 CEMENT BAG+ 2 SAND BAGS+ 3 CRUSHED STONE BAGS + 2 CANS OF WATER.	1.1 a)		9			
COLUMN: STEEL DIAMETER	3/8" STEEL WITH 1/4" STIRRUPS ONE AT 5CM, 4 AT 10 CM. AND THE OTHERS AT 25 CM IN BOTH DIRECTIONS.	2.2 c)		10			
BEAM: CONCRETE 210/CM2	DOSES BY MIXING (1:2:3) 1 CEMENT BAG+ 2 SAND BAGS+ 3 CRUSHED STONES+ 2 CANS OF WATER.	1.1 a)		11			

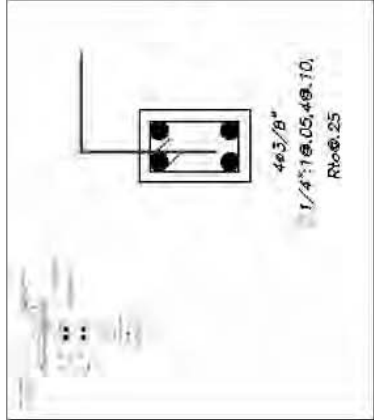


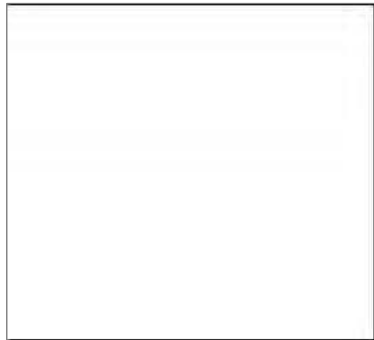
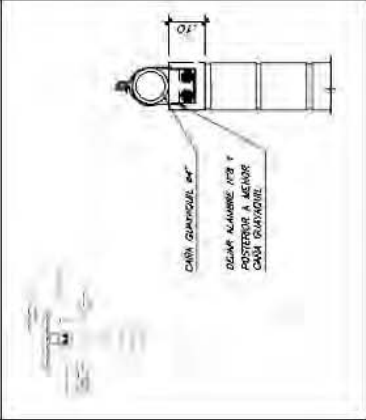
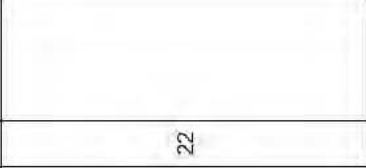

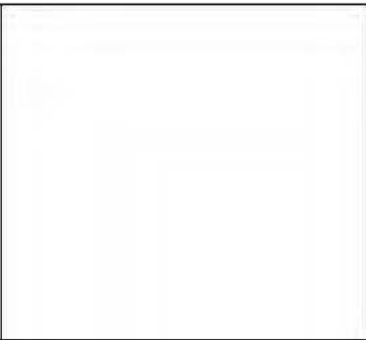
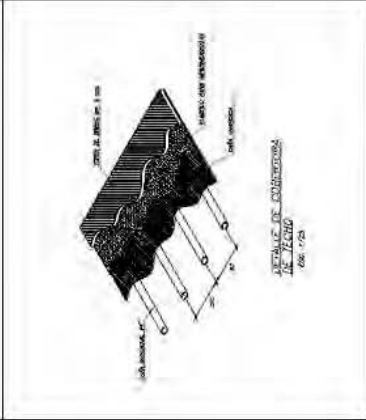


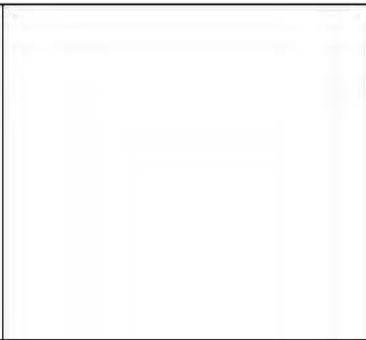
2.2.- INSPECTION N° 2

ACTIVITY	DESCRIPTION	MINIMUM REQUIREMENTS	ILLUSTRATION	No.	SATISFACTORY	NO CONFORME	OBSERVACIONES
BEAM: STEEL DIAMETER	3/8" STEEL WITH 1/4" STIRRUPS ONE AT 5CM, 4 AT 10 CM, AND THE OTHERS AT 25 CM IN BOTH DIRECTIONS.	2.2 c)		12			
MORTAR JOINT THICKNESS	DOSING BY MIXING (1:4) 1 CEMENT BAG + 4 SAND BAGS	1.2 a)		13			
MORTAR JOINT THICKNESS	JOINT THICKNESS BETWEEN BRICKS BETWEEN 1 and 1.5 CM	3.4		14			



BRICK LAYING	VERIFY THAT WALLS ARE LAID WITH HOLWS DOWN, LENGHTWAYS OR WITH HOLES DOWNWARD AND BREADTHWAYS			15		
CONFINMENT ANCHORS OF WALL WITH COLUMN	1/4" STEEL WITH 40 CM AT THE INTERIOR OF THE WALL, 12.5 CM AT THE INTERIOR OF THE COLUMN AND WITH 10 CM FOOT, EACH 4 BRICK FASTENINGS	3.2		16		
CONFINMENT JAG OF WALL WITH COLUMN	5 CM JAG	3.2		17		

2.3.- INSPECTION N° 3							
ACTIVITY	DESCRIPTION	MINIMUM REQUIREMENTS	ILLUSTRATION	No.	SATISFACTORY	UNSATISFACTORY	OBSERVACIONES
INSTALLATIONS SHOULD NOT CUT MEMBERS	VERIFY THAT ELECTRIC, WATER AND DRAINAGE PIPELINES ARE LOCATED IN WALLS AND NOT IN BEAMS/COLUMNS.			18			
ELECTRIC INSTALLATIONS	TYPE AND SIZE OF POWER SUPPLY PIPE LINES, TYPE OF CABLES, QUANTITY OF POWER OUTLETS, SWITCHES, POWER USE POINTS, METERS AND SWITCH BOARD			19			
SANITARY INSTALLATIONS	TYPE AND SIZE OF WATER AND SEWAGE PIPE LINES, PIPING ROUTE, QUANTITY OF VALVES, WATER USE POINTS, SEWAGE MANHOLE, ETC.			20			

<p>FASTENING ANCHORS AND/OR FUTURE EXPANSION</p>	<p>SHOULD BE 10 CM INSIDE THE BEAM . FASTENING THE CANA WITH A 20 CM. FOOT FOR FUTURE EXPANSIONS.</p>	 <p>21</p>			
<p>FASTENING WIRE</p>	<p>Nº 8 WIRE (FASTENING WIRE) FROM THE INTERIOR OF THE BEAM TO FASTEN THE</p>	 <p>22</p>			
<p>SEPARATION BETWEEN CANAS</p>	<p>50 CM. FASTENED TO THE HOOKS AND/OR ANCHORS OF THE BEAM</p>	 <p>23</p>			

**2.4.- INSPECTION N° 4**

ACTIVITY	DESCRIPTION	MINIMUM REQUIREMENTS	ILLUSTRATION	No.	SATISFACTORY	UNSATISFACTORY	OBSERVACIONES
WORK COMPLETION	VERIFY THE TYPE OF FINISHING USED AND THE WORK COMPLETION						

## **Appendix 2: Minimum Requirements for Safer Housing**

### **MINIMUM REQUIREMENTS FOR SAFER HOUSING**

The Minimum Requirements are established in conformity with  
Peruvian National Building Code

JICA Study Team

1. Quality of Materials
2. Structural Section of Main Members
3. Connection of Structural Members

#### **1. Quality of Materials**

##### **1.1 Concrete**

- a) Mixture design for reinforced tie beam is one (1) portion of Portland cement, two (2) portions of clean coarse sand, four (4) portions of crushed stone (the size is less than 1/2") and one (1) portion of clean and drinkable water. Mixture design for non reinforced tie beam is one (1) portion of Portland cement, eight (8) portions of hormigon, two and half (2.5) portions of medium stones (the size is maximum 4") and one and quarter (1.25) portions of clean and drinkable water.

Mixture design for confined columns, ring beams and light slab is one (1) portion of Portland cement, two (2) portions of clean coarse sand, three (3) portions of clean crushed stone (the size is less than 1/2") and one (1) portion of clean and drinkable water.

In case of salty soil for foundation, vinyl sheet is used to prevent salt damage of concrete.

- b) Materials are well mixed where the aggregate is not visible and poured to form work immediately.
- c) Form work is hard and no bleeding.
- d) Any gaps and void is avoided by using a stick to compact concrete when it is pouring.

##### **1.2 Mortar**

Mixture design is one (1) portion of Portland cement and four (4) portions of clean coarse sand.

##### **1.3 Foundation**

Mixture design for foundation is one (1) portion of Portland cement, ten (10) portions of hormigon, one and half (1.5) portions of clean and drinkable water and three (3) portions of large stones (the size is maximum 10")

*Hormigon* is composed of gravel and coarse sand directly obtained from quarry place

##### **1.4 Wood**

Wood is hard, dry, dense fiber, well cured, no crack and straight.

##### **1.5 Brick**

Brick is burned and orange color without white pale shadow. Brick is also dust free, without cracks or bending.

##### **1.6 Water**

Water is clean and drinkable.

## **2. Structural Section of Main Members**

Wall of confined masonry house is enclosed firmly with reinforced concrete tie beam, reinforced concrete column and reinforced concrete ring beam on a stable foundation with enough strength. Every vertical part of wall corner is firmly connected, forming confined elements.

### **2.1 Foundation**

Foundation width and height is 60 cm or more. In case of the foundation without loads from small beams of roofing, the width of foundation can be 50 cm. Foundation depth is no less than 80 cm.

### **2.2 Sections of reinforced concrete member**

- a) Tie beam width is 13 cm or 24 cm according to the width of the wall. The minimum height is 50 cm. Tie beam is reinforced with four (4) steel bars of 3/8" diameter, with stirrups of 1/4" diameter at 20 cm intervals. If the soil is mainly composed of slime and/or sand, the tie beam is needed to be reinforced.
- b) Maximum wall area framed with tie beam, column and ring beam is 12.0 m<sup>2</sup>. The maximum height of the wall is 2.4 m.
- c) Column has a minimum section of 13 cm wide and 15 cm high, and four (4) steel bars of 3/8" diameter are placed with hoops of 1/4" diameter. Five (5) hoops are placed from the connection point with tie beam. First hoop is placed at 5 cm from the connection point. The other four (4) hoops above the first hoop are placed at 10 cm interval. Another five (5) hoops are placed from the point with ring beam as the same case from the connection of tie beam. At the rest space of column hoops are placed at 25 cm interval. Additionally, two (2) stirrups are placed in joint of column and ring beam at 10 cm interval. Three (3) stirrups are also placed in joint of column and tie beam at 15 cm interval.
- d) Minimum dimension of ring beam is 13 cm wide and 20 cm high, and four (4) steel bars of 3/8" diameter are placed with stirrups of 1/4" diameter. Five (5) stirrups are placed from the connection point with column. First stirrup is placed at 5 cm from the connection point. The other four (4) stirrups beside the first stirrup are placed at 10 cm interval. Another five (5) stirrups are placed from the connection point with the other column as the same case from the connection of the other above mentioned column. At the rest space of ring beam space stirrups are placed at 25 cm interval.
- e) Minimum covering depth of concrete is 2 cm for walls with finish and 3 cm for walls without finish. In case of foundation, covering depth is 7.5 cm.
- f) Minimum length of structural wall is 1.2 m.

### **2.3 Maximum span**

Maximum span of columns is 5.0 m in case of 24 cm wide wall. It is 3.5 m in case of 13 cm wide wall.

### **3. Connection of Structural Members**

#### **3.1 Anchor of column to tie beam and ring beam**

Four (4) steel bars of column anchor to the foundation. The steel bars bend 90° at 7.5 cm from the bottom of foundation. The bended steel bars are prolonged 25 cm. In case of reinforced tie beam, the steel bars of column and tie beam must be carefully tied by steel wires to ensure an adequate connection between these structural elements. In case of good soil, concrete without reinforcement is used. In the same way, four (4) steel bars of column anchor to reinforced ring beam. The steel bars bend 90° at 2 cm from the top of ring beam. The bended steel bars are prolonged 25 cm measured from the column surface.

#### **3.2 Connection of wall and column**

There are two connection methods. One is that joint between wall and columns is geared and the length of the salient part of brick does not exceed 5 cm. The other is that two (2) steel bars of 1/4" diameter anchor at every four (4) layers of wall bricks at least 40 cm inside masonry and 12.5 cm inside column with vertical turning of 90° at 10 cm.


#### **3.3 Overlapping of reinforcements**

Steel bars of reinforced concrete overlap at least at 40 cm.


#### **3.4 Wall joint mortar thickness**

Thickness of joint mortar for wall is from 1.0 to 1.5 cm.

# Appendix 3: Poster of Minimum Requirements for Safer Housing



## MINIMUM REQUIREMENTS FOR SAFER HOUSING



**1. QUALITY OF MATERIALS**

**2. STRUCTURAL SECTION OF MAIN MEMBERS**


**3. CONNECTION OF STRUCTURAL MEMBERS**

### 1. QUALITY OF MATERIALS:

#### 1.1 CONCRETE


**a) REINFORCED TIE BEAM**

Make a design for members to be reinforced in 1/3 portion of Portland cement, two portions of clean coarse sand, four (4) portions of crushed stone (the size is between 4.75 and 12.5 mm) and double water.



**COLUMNS, RING BEAMS, LIGHT SLAB**

Make a design for members to be reinforced in 1/3 portion of Portland cement, two portions of clean coarse sand, four (4) portions of crushed stone (the size is between 4.75 and 12.5 mm) and double water.




**b) Materials are well mixed, above the aggregate is not visible and pointed to form work immediately.**

**c) Form work is tied and not moving.**


#### 1.2 MORTAR

Make a design for members to be reinforced in 1/3 portion of Portland cement and four (4) portions of clean coarse sand.




#### 1.3 FOUNDATION

Make a design for foundation to be reinforced in 1/3 portion of Portland cement, for 100 portions of terrazzo, one and half (1.5) portions of clean sand and double water and three (3) portions of slag stones (the size is maximum 10"). Terrazzo is composed of gravel and coarse sand (only obtained from quarry plants).




#### 1.4 WOOD

Wood is hard, dry, clean, free of rot, insect, no crack and straight.



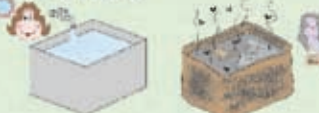
#### 1.5 BRICK

Brick is a soft, dry, average color without surface flaws. Brick is a soft, dry, without cracks or blemish.



#### 1.6 WATER


Water is clean and drinkable.



### 2. STRUCTURAL SECTION OF MAIN MEMBERS:

#### 2.1 FOUNDATION

The foundation width is higher 400 mm structure. The width of foundation can be 50 or 70 cm. The depth is no less than 50 cm.



#### 2.2 SECTIONS OF REINFORCED CONCRETE MEMBER

**a)** The beam width is 15 cm or 20 cm (maximum) for the tie beam. The cross-section height of the beam and column must be 40 cm. The reinforcement is placed in the center of the beam and column.


**b)** The column width is 15 cm or 20 cm (maximum) for the tie beam. The cross-section height of the column must be 40 cm. The reinforcement is placed in the center of the column.

**c)** The column width is 15 cm or 20 cm (maximum) for the tie beam. The cross-section height of the column must be 40 cm. The reinforcement is placed in the center of the column.

**d)** The column width is 15 cm or 20 cm (maximum) for the tie beam. The cross-section height of the column must be 40 cm. The reinforcement is placed in the center of the column.


**e) COVERING**

The covering of the reinforcement is 20 mm for the top and bottom, and 10 mm for the side and corner.



#### 2.3 MAXIMUM SPAN


Make a design of structure of the size of 1/3 or double the size of the structure.



### 3. CONNECTION OF STRUCTURAL MEMBERS:

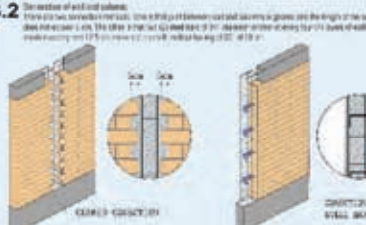
#### 3.1

Make a design of structure of the size of 1/3 or double the size of the structure.



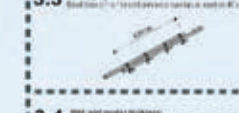
#### 3.2

The connection of wall and column. There is 20 cm connection height. The height of the column and wall must be 40 cm. The reinforcement is placed in the center of the column and wall.




#### 3.3

The connection of column and wall. The height of the column and wall must be 40 cm. The reinforcement is placed in the center of the column and wall.



#### 3.4

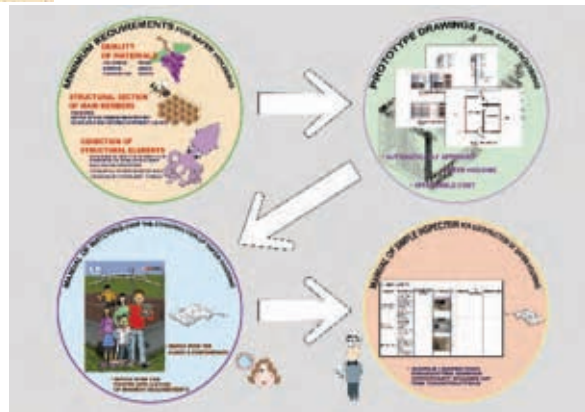
The connection of wall and column. The height of the column and wall must be 40 cm. The reinforcement is placed in the center of the column and wall.



Source) The Study on Housing Reconstruction with Seismic-Resistant Housings in the Republic of Peru, JICA Study Team



## Appendix 4: Pamphlet of Prototype Drawings for Safer Housing



Source) The Study on Housing Reconstruction with Seismic-Resistant Housing in the Republic of Peru, JICA Study Team

## Appendix 5: Matrix for the Selection of Prototype Drawings

<b>MATRIX OF PROTOTYPE N° 1</b>									
<b>PROJECT: STUDY OF RECONSTRUCTION OF SEISMIC-RESISTANT HOUSING IN THE REPUBLIC OF PERU</b>									
<b>LOCATION: PUEBLO NUEVO - LA TINGUIÑA - INDEPENDENCIA</b>									
CONSTRUCTION AREA		KIND OF SOIL / FOUNDATION		KIND OF ROOF	ELECTRICAL INSTALLATIONS	KIND OF SANITARY INSTALLATIONS	CODIFICATION	COST S/.	COST S/. INCL. IGTV
		CHARACTERISTICS	FOOTING						
<b>PROTOTYPE 1 BONO 6000</b>	<b>AREA 16.38 m2</b>	REGULAR RESISTANCE GRANULAR MATERIAL WITH COBBLES OF SMALL TO BIG STONES σ/Aceptable soil 1.2 @ Max.kg/cm2	SIMPLE	VOIDED SLAB OF REINFORCED CONCRETE	AVAILABLE	WITH LATRINE	PROTOTYPE 1 No. 01	6,848.19	8,149.35
					NOT AVAILABLE	WITHOUT LATRINE	PROTOTYPE 1 No. 02	5,900.54	7,021.75
					AVAILABLE	WITH LATRINE	PROTOTYPE 1 No. 03	6,412.08	7,630.38
					NOT AVAILABLE	WITHOUT LATRINE	PROTOTYPE 1 No. 04	5,464.53	6,502.79
				VOIDED ROOF WITH GUAYACUIL CAME AND MUD CAKE	AVAILABLE	WITH LATRINE	PROTOTYPE 1 No. 05	5,940.96	7,069.74
					NOT AVAILABLE	WITHOUT LATRINE	PROTOTYPE 1 No. 06	4,993.42	5,942.17
					AVAILABLE	WITH LATRINE	PROTOTYPE 1 No. 07	5,504.85	6,550.77
					NOT AVAILABLE	WITHOUT LATRINE	PROTOTYPE 1 No. 08	4,557.31	5,423.20
	LOW RESISTANCE SAND OR CLAY WITHOUT COBBLES σ/Aceptable soil 0.8 @ 1.2 kg/cm2	REINFORCED	VOIDED SLAB OF REINFORCED CONCRETE	AVAILABLE	WITH LATRINE	PROTOTYPE 1 No. 09	7,105.81	8,455.91	
				NOT AVAILABLE	WITHOUT LATRINE	PROTOTYPE 1 No. 10	6,158.27	7,328.34	
				AVAILABLE	WITH LATRINE	PROTOTYPE 1 No. 11	6,669.70	7,936.94	
				NOT AVAILABLE	WITHOUT LATRINE	PROTOTYPE 1 No. 12	5,722.16	6,809.37	
			VOIDED ROOF WITH GUAYACUIL CAME AND MUD CAKE	AVAILABLE	WITH LATRINE	PROTOTYPE 1 No. 13	6,198.59	7,376.32	
				NOT AVAILABLE	WITHOUT LATRINE	PROTOTYPE 1 No. 14	5,251.05	6,248.75	
				AVAILABLE	WITH LATRINE	PROTOTYPE 1 No. 15	5,762.48	6,857.35	
				NOT AVAILABLE	WITHOUT LATRINE	PROTOTYPE 1 No. 16	4,814.94	5,729.78	

**Matrix for the Selection of Prototype Drawings 1**

<b>MATRIX OF PROTOTYPE N° 2</b>									
<b>PROJECT: STUDY OF RECONSTRUCTION OF SEISMIC-RESISTANT HOUSING IN THE REPUBLIC OF PERU</b>									
<b>LOCATION: PUEBLO NUEVO - LA TINGUIÑA - INDEPENDENCIA</b>									
CONSTRUCTION AREA		KIND OF SOIL / FOUNDATION		KIND OF ROOF	ELECTRICAL INSTALLATIONS	KIND OF SANITARY INSTALLATIONS	CODIFICATION	COST S/.	COST S/. INCL. IGTV
		CHARACTERISTICS	FOOTING						
<b>PROTOTYPE 2 TECNO PROPIO BFH 13400</b>	<b>AREA 35.47 m2</b>	REGULAR RESISTANCE GRANULAR MATERIAL WITH COBBLES OF SMALL TO BIG STONES σ/Aceptable soil 1.2 @ Max.kg/cm2	SIMPLE	VOIDED SLAB OF REINFORCED CONCRETE	AVAILABLE	BATHROOM	PROTOTYPE 2 No. 01	13,727.94	16,336.25
					NOT AVAILABLE	LATRINE	PROTOTYPE 2 No. 02	12,962.26	15,425.09
					AVAILABLE	BATHROOM	PROTOTYPE 2 No. 03	13,058.15	15,539.20
					NOT AVAILABLE	LATRINE	PROTOTYPE 2 No. 04	12,333.67	14,677.07
				VOIDED ROOF WITH GUAYACUIL CAME AND MUD CAKE	AVAILABLE	BATHROOM	PROTOTYPE 2 No. 05	11,676.87	14,133.48
					NOT AVAILABLE	LATRINE	PROTOTYPE 2 No. 06	11,088.34	13,195.12
					AVAILABLE	BATHROOM	PROTOTYPE 2 No. 07	11,207.07	13,336.41
					NOT AVAILABLE	LATRINE	PROTOTYPE 2 No. 08	10,459.75	12,447.10
	LOW RESISTANCE SAND OR CLAY WITHOUT COBBLES σ/Aceptable soil 0.8 @ 1.2 kg/cm2	REINFORCED	VOIDED SLAB OF REINFORCED CONCRETE	AVAILABLE	BATHROOM	PROTOTYPE 2 No. 09	14,238.98	16,944.39	
				NOT AVAILABLE	LATRINE	PROTOTYPE 2 No. 10	13,440.14	15,993.77	
				AVAILABLE	BATHROOM	PROTOTYPE 2 No. 11	13,569.19	16,147.34	
			VOIDED ROOF WITH GUAYACUIL CAME AND MUD CAKE	NOT AVAILABLE	LATRINE	PROTOTYPE 2 No. 12	12,811.55	15,245.74	
				AVAILABLE	BATHROOM	PROTOTYPE 2 No. 13	12,387.90	14,741.60	
				NOT AVAILABLE	LATRINE	PROTOTYPE 2 No. 14	11,566.23	13,763.81	
				AVAILABLE	BATHROOM	PROTOTYPE 2 No. 15	11,718.11	13,944.55	
NOT AVAILABLE	LATRINE	PROTOTYPE 2 No. 16	10,937.64	13,015.79					

**Matrix for the Selection of Prototype Drawings 2**

<b>MATRIX OF PROTOTYPE N° 3</b>									
PROJECT: STUDY OF RECONSTRUCTION OF SEISMIC-RESISTANT HOUSING IN THE REPUBLIC OF PERU									
LOCATION: PUEBLO NUEVO - LA TINGUIÑA - INDEPENDENCIA									
CONSTRUCTION AREA	KIND OF SOIL / FOUNDATION		KIND OF ROOF	ELECTRICAL INSTALLATIONS	KIND OF SANITARY INSTALLATIONS	CODIFICATION	COST S/.	COST S/. INCL. IGV	
	CHARACTERISTICS	FOOTING							
<b>PROTOTYPE 3 S/. 15400</b>	<b>AREA 43.23 m2</b>	REGULAR RESISTANCE GRANULAR MATERIAL WITH COBBLES OF SMALL TO BIG STONES σ acceptable soil 1.7 @ 1.2 kg/cm2	SIMPLE	VOIDED SLAB OF REINFORCED CONCRETE	AVAILABLE	BATHROOM	PROTOTYPE 3 No. 01	17,371.36	20,671.92
					NOT AVAILABLE	LATRINE	PROTOTYPE 3 No. 02	16,458.16	19,585.21
					AVAILABLE	BATHROOM	PROTOTYPE 3 No. 03	16,611.29	19,767.44
					NOT AVAILABLE	LATRINE	PROTOTYPE 3 No. 04	15,733.53	18,722.90
		LOW RESISTANCE SAND OR CLAY WITHOUT COBBLES σ acceptable soil 0.8 @ 1.2 kg/cm2	REINFORCED	VOIDED ROOF WITH GUAYAQUIL CANE AND MUD CAKE	AVAILABLE	BATHROOM	PROTOTYPE 3 No. 05	14,591.30	17,363.65
					NOT AVAILABLE	LATRINE	PROTOTYPE 3 No. 06	13,299.57	16,421.49
					AVAILABLE	BATHROOM	PROTOTYPE 3 No. 07	13,801.23	16,459.16
					NOT AVAILABLE	LATRINE	PROTOTYPE 3 No. 08	13,074.94	15,559.18
	VOIDED SLAB OF REINFORCED CONCRETE	SIMPLE	VOIDED ROOF WITH GUAYAQUIL CANE AND MUD CAKE	AVAILABLE	BATHROOM	PROTOTYPE 3 No. 09	18,014.27	21,436.98	
				NOT AVAILABLE	LATRINE	PROTOTYPE 3 No. 10	17,046.25	20,285.04	
				AVAILABLE	BATHROOM	PROTOTYPE 3 No. 11	17,254.20	20,532.50	
				NOT AVAILABLE	LATRINE	PROTOTYPE 3 No. 12	16,321.63	19,422.74	
		REINFORCED	VOIDED ROOF WITH GUAYAQUIL CANE AND MUD CAKE	AVAILABLE	BATHROOM	PROTOTYPE 3 No. 13	15,234.22	18,128.72	
				NOT AVAILABLE	LATRINE	PROTOTYPE 3 No. 14	14,387.67	17,121.33	
				AVAILABLE	BATHROOM	PROTOTYPE 3 No. 15	14,474.15	17,224.24	
				NOT AVAILABLE	LATRINE	PROTOTYPE 3 No. 16	13,663.04	16,259.02	

**Matrix for the Selection of Prototype Drawings 3**

<b>MATRIX OF PROTOTYPE N° 4</b>									
PROJECT: STUDY OF RECONSTRUCTION OF SEISMIC-RESISTANT HOUSING IN THE REPUBLIC OF PERU									
LOCATION: PUEBLO NUEVO - LA TINGUIÑA - INDEPENDENCIA									
CONSTRUCTION AREA	KIND OF SOIL / FOUNDATION		KIND OF ROOF	ELECTRICAL INSTALLATIONS	KIND OF SANITARY INSTALLATIONS	CODIFICATION	COST S/.	COST S/. INCL. IGV	
	CHARACTERISTICS	FOOTING							
<b>PROTOTYPE 4 BONO 6000 + TECNO PROPIO BFH 13400</b>	<b>AREA 53.13 m2</b>	REGULAR RESISTANCE GRANULAR MATERIAL WITH COBBLES OF SMALL TO BIG STONES σ Acceptable soil 1.2 @ 1.2 kg/cm2	SIMPLE	VOIDED SLAB OF REINFORCED CONCRETE	AVAILABLE	BATHROOM	PROTOTYPE 4 No. 01	19,300.73	22,967.87
					NOT AVAILABLE	LATRINE	PROTOTYPE 4 No. 02	18,305.15	21,800.23
					AVAILABLE	BATHROOM	PROTOTYPE 4 No. 03	18,387.87	21,881.57
					NOT AVAILABLE	LATRINE	PROTOTYPE 4 No. 04	17,523.49	20,852.95
		LOW RESISTANCE SAND OR CLAY WITHOUT COBBLES σ Acceptable soil 0.8 @ 1.2 kg/cm2	REINFORCED	VOIDED ROOF WITH GUAYAQUIL CANE AND MUD CAKE	AVAILABLE	BATHROOM	PROTOTYPE 4 No. 05	16,670.86	19,838.32
					NOT AVAILABLE	LATRINE	PROTOTYPE 4 No. 06	15,802.38	18,804.83
					AVAILABLE	BATHROOM	PROTOTYPE 4 No. 07	15,758.00	18,752.02
					NOT AVAILABLE	LATRINE	PROTOTYPE 4 No. 08	14,930.72	17,767.56
	VOIDED SLAB OF REINFORCED CONCRETE	SIMPLE	VOIDED ROOF WITH GUAYAQUIL CANE AND MUD CAKE	AVAILABLE	BATHROOM	PROTOTYPE 4 No. 09	20,042.38	23,850.43	
				NOT AVAILABLE	LATRINE	PROTOTYPE 4 No. 10	19,081.97	22,707.54	
				AVAILABLE	BATHROOM	PROTOTYPE 4 No. 11	19,129.52	22,764.13	
				NOT AVAILABLE	LATRINE	PROTOTYPE 4 No. 12	18,210.31	21,670.27	
		REINFORCED	VOIDED ROOF WITH GUAYAQUIL CANE AND MUD CAKE	AVAILABLE	BATHROOM	PROTOTYPE 4 No. 13	17,412.51	20,720.89	
				NOT AVAILABLE	LATRINE	PROTOTYPE 4 No. 14	16,489.21	19,622.16	
				AVAILABLE	BATHROOM	PROTOTYPE 4 No. 15	16,409.65	19,634.58	
				NOT AVAILABLE	LATRINE	PROTOTYPE 4 No. 16	15,617.55	18,584.88	

**Matrix for the Selection of Prototype Drawings 4**

## Appendix 6: Schedule of Inspections

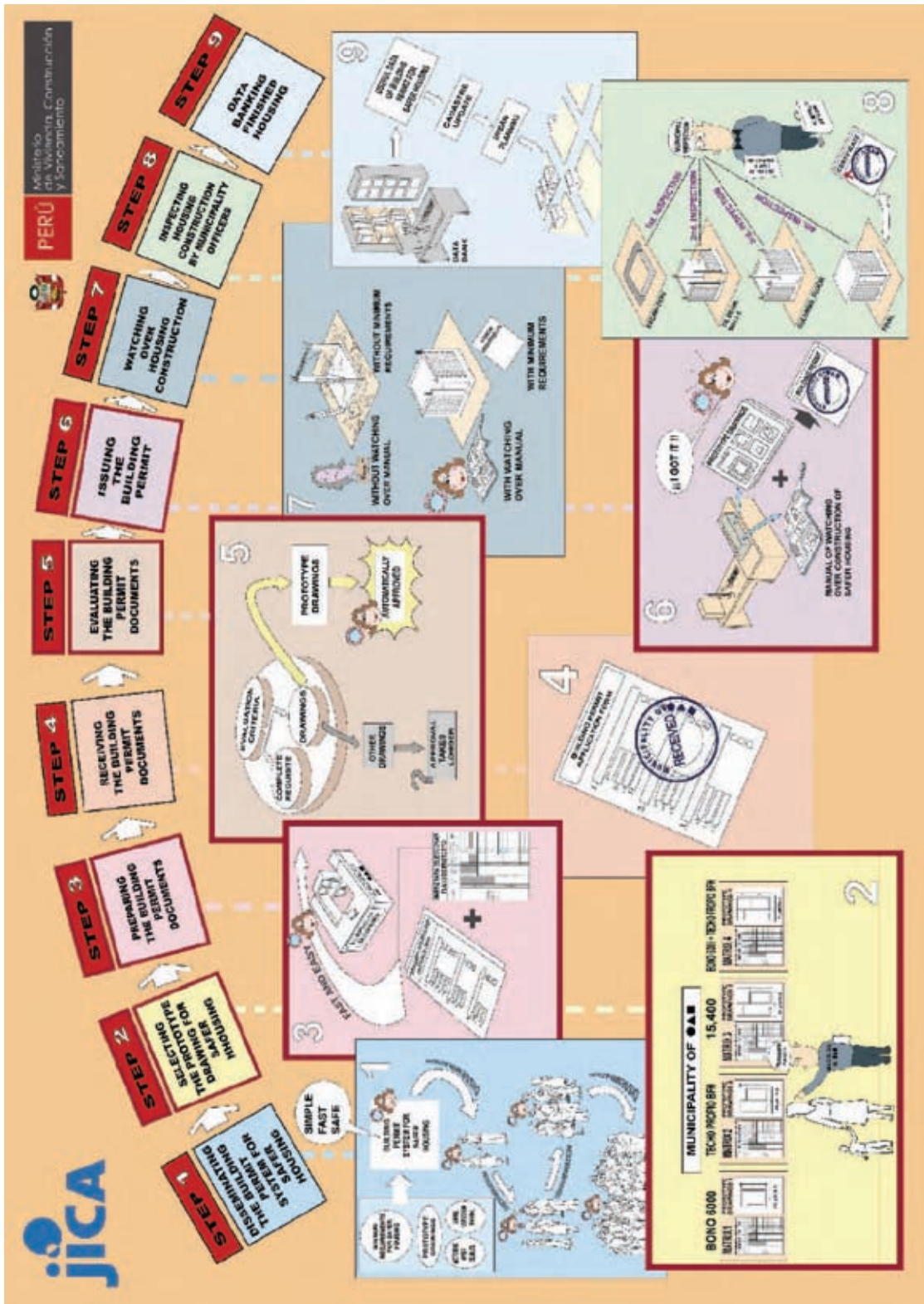
SCHEDULE OF INSPECTION AND CONSTRUCTION		WEEK 1							WEEK 2							WEEK 3							WEEK 4							WEEK 5							WEEK 6						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
ITEM	DESCRIPTION																																										
	INSPECTION 1																																										
	1 FACADE ALIGNMENT																																										
	2 OUTLINE																																										
	3 TYPE OF SOIL																																										
	4 FOUNDATION DEPTH																																										
	5 FOUNDATION WIDTH																																										
	6 CYCLING CONCRETE FOR CEMENT																																										
	7 CONCRETE FOR REINFORCED THE BEAM																																										
	8 STEEL DIAMETER IN REINFORCED THE BEAM																																										
	INSPECTION 2																																										
	9 CONCRETE IN COLUMN																																										
	10 STEEL DIAMETER IN COLUMN																																										
	11 CONCRETE IN BEAM																																										
	12 STEEL DIAMETER IN BEAM																																										
	13 MORTAR JOINTS																																										
	14 MORTAR THICKNESS																																										
	15 BRICK LAYS																																										
	16 CONFINEMENT ANCHOR																																										
	17 AS/SED COMPLEMENT																																										
	INSPECTION 3																																										
	18 VERIFY NOT CUT STRUCTURES																																										
	19 ELECTRIC INSTALLATIONS																																										
	20 SHUTTER INSTALLATIONS																																										
	21 FASTENING HOOKS FOR FUTURE EXPANSION																																										
	22 FASTENING WIRE																																										
	23 SEPARATION BETWEEN CHAIRS																																										
	INSPECTION 4																																										
	WORK COMPLETION																																										

NOTE: ADEQUATE DATE FOR INSPECTION (CHOOSE ONE DAY)

Source) The Study on Housing Reconstruction with Seismic-Resistant Housings in the Republic of Peru, JICA Study Team



# Appendix 7: Flow Chart of the Improved Building Permit System



Source) The Study on Housing Reconstruction with Seismic-Resistant Housings in the Republic of Peru, JICA Study Team

## **Appendix 8: Table of Contents "Manual of Watching Over Safer Housing Construction"**

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  - 3.6. TIE BEAM WORKS
  - 3.7. ROOFING WORKS
  - 3.8. FINISHING WORKS

# The Study on Housing Reconstruction with Seismic-resistant Houses in the Republic