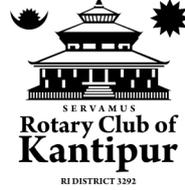


**BHIMPHEDI AWASUKA**



*Program developed by:*

**AMICS DEL NEPAL \* BASE A \* CCD-UPC University**



# **AWASUKA PROGRAM**

implemented in Bhimpheedi through

## **A G R A G A A M I**

### **KRISHAK KRISHI SAHAKAARI SASTA**

## **REPORT**

**for Bhimpheedi Gaunpalika**

March 2018

## **AWASUKA PROGRAM**

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## 1. PROGRAM SUMMARY IN BHIMPHEDI

### 1.1. OBJECTIVES

The main aim of the program is to strengthen and empower the community by providing knowledge and skills, in order to acquire a greater capacity for response to future earthquakes. This development program is intended to act both from the educational, productive and organizational perspectives, meaning that the population's capacity for management and decision-making will be highly improved. Therefore, the actions to be carried out will focus on **training** and **providing technical assistance** to the people, in order to build earthquake-resistant houses, so that the population, in an active way, will have the know-how and will be able to solve future similar situations.

### 1.2. ENTITIES INVOLVED

Several entities have partnered to facilitate this program: **Amics del Nepal NGO** contributes with the knowledge of the village, the population, the social situation, the culture, and provides general coordination; **Base-A NGO** contributes with their experience in cooperation projects, provides technical coordination along with an architect from Amics del Nepal, as well as volunteer coordination, monitoring and evaluation of the program, **CCD-UPC Polytechnic University of Catalonia (UPC)** contributes in the participation of volunteer students, as well as providing an expert advisor for the Program. Professor PhD. Architect Mr Pedro Lorenzo, who has extensive experience in anti-seismical reconstruction and construction in poverty and emergency situations, leads the program implementation and keeps track of all its actions. Both University students and Professor travel to the site with the economic support of CCD - Center for Development Cooperation at UPC University; **Agragaami Krishak Krishi Sahakaari**, a local agricultural cooperative in Bhimpheedi, which knows the population and provides social organisation; and **Rotary Club of Kantipur**, who provides legal, logistical and administrative support to the Awasuka Program.

Amics del Nepal is a Non-Governmental Organization registered in Barcelona, Catalonia, has been operating in Nepal since 1995 to improve the life-conditions of needy children, youths, women and other underprivileged groups, in the fields of health, education and community development, within a framework of sustainability and respect for the Nepalese culture. It also has the goal to disseminate the cultural and social current situation of Nepal in the Spanish society, through the organization of different awareness activities.

### **1.3. PROTOTYPES in BHIMPHEDI**

As the program funds were humble, it was decided to build first some prototypes in Bhimpheedi - which would also be useful for the people – and after that, it would be possible to analyze the construction costs and decide which was the most inexpensive building technique for the people in Bhimpheedi area.

The prototypes were built in 3 different techniques: Dhunga Mato, Patra Ku-Kat and Confined Block.

#### **1.3.1. Dhunga Mato**

The *Dhunga-Mato* house was built because 3E Project commissioned to Awasuka an earthquake-resistant building to house some facilities for the multisports court: dressing rooms, showers and store-room. This prototype was entirely financed by 3E Project and Awasuka and the use of it will be granted to the people of Bhimpheedi, always coordinated by 3E Project.

*Dhunga Mato*, stone and mud, and inner wooden structure, is the most common construction technique used in rural areas of Nepal. After 2015 earthquake, Awasuka team analyzed the Dhunga Mato structures existing in Bhimpheedi VDC, finding that they already had some earthquake resistant features, but they also needed new elements to improve their bracing and stiffness: Diagonal Braces in Pillars (done through Stiffening Modules), Diagonal Braces in Floors and Roofs, Horizontal Bands tying stone walls (inside and outside) and Horizontal Bands tying joists along wall: Ring Beam.

#### **1.3.2. Patra Ku-Kat**

The *Patra Ku-Kat* house was built as an improved temporary shelter. This type of house should be dismantable, as some people don't own a land and need to have a shelter built in someone else's land. But later on, they can take it away once they have a land of their own. This prototype was financed half by Awasuka and half by the beneficiary who lives there (Balmandir staff).

*Patra Ku-Kath* is an inexpensive wood commonly used for scaffolding. As wood is expensive, Awasuka team proposed to build a light-quick-construction house using prefabricated panels made of Patra. It can be used as a temporary shelter and as a permanent house. Additionally, typical temporary shelters have bad thermal behavior due to CGI sheets, whereas patra construction improves thermal comfort. These are the improvements made to this shelter: Plinth Beam connected to wall panels, prefabricated panels with diagonals at corners, Roof diagonals added at horizontal planes and Wooden walls and insulated roof provide thermal comfort.

### 1.3.3. Confined Block

The *Confined Block* house was built to test the “*confined masonry*” technique, a low cost earthquake-resistant technique used world-wide, which was yet not being implemented in Nepal. This house was built very close to Awasuka Office, so it was easy to supervise. This prototype was financed half by Awasuka and half by the beneficiary who lives there (Balmandir staff).

*Confined Masonry* is an earthquake-resistant technique used in many countries. It can be done using different materials, but the most common one is concrete block. In Nepal concrete blocks are widely used for construction, but the lack of confining elements makes them very vulnerable to earthquakes. After 2015 earthquake, Awasuka team decided to implement this technique in Bhimphedi area, to improve the quality of these constructions: Plinth Beam connected to walls and pillars, Confining Elements added: Pillars and Ring Beams, Reinforcements added: vertically and horizontally and Wall corners braced with rods.

### 1.3.4. Model House approved by NRA: Confined Block

After finishing the three prototypes, it was seen that the Confined Block house was the most inexpensive building technique, so Awasuka prepared all the documents to get an Approval by the NRA engineers in Kathmandu. This way we could build our own design of Confined Block Masonry, a bit different than the one in the Government Catalogue. By doing this, the beneficiaries could also benefit from the government help, as this model is also in the Government Catalogue now.

This approval process started in July 2017 and finally the **Model House of Confined Hollow Concrete Block** was approved mid January 2018.

## 1.4. HOUSES IN SUPIN

Agragaami and Awasuka Team decided which community should be the first to start building new houses. After some discussion, all the different parties (Amics del Nepal, Base-A, UPC and Agragaami) agreed that the first community to be helped should be Supin, as it was the most affected ward in the former Bhimphedi VDC area.

After some time, the specific beneficiaries were selected by Agragaami, resulting of 7 houses to be built anew and 5 houses to be retrofitted. From this selection, 2 new houses are in Tallo Supin and the rest are in Matilo Supin, a much poorer community.

#### **1.4.1. Credited Houses**

Credits are granted to the house beneficiaries, but not in form of money: only for materials purchase. The credits are managed by Agragaamai, in collaboration with Awasuka Technical Team. Materials are purchased by Awasuka Technical Team, following the technical drawings of the agreed design and in full agreement with each beneficiary. The maximum credit amount per beneficiary is 2 lakhs, an amount that has to be paid back in 5 years. Rotary Club of Kantipur is also monitoring this process. Once the credits are returned, this incoming money will be used to be able to help more beneficiaries in their house construction.

#### **1.4.2. Social Houses**

Some families with disabilities were located by Agragaami. These families are needy and they could never pay a credit back. Thus, these houses have been entirely financed by Awasuka Program. There are 2 social houses amongst the 7 new houses, and 1 social house amongst the 5 retrofitted ones.

### **5. AWASUKA SPACES and TECHNICAL TEAM in BHIMPHEDI**

To be able to run the program, AWASUKA Program settled an office at Janajati Hall, sharing the space with Agragaami Krishak Krishi Sahakari. The program also wanted to foster the prefabrication of different construction elements, therefore a workshop and storehouse was also settled in Bhimpheedi, located on the way to Simaltar.

As per the technical follow-up of the program, there is always a young team of architects and engineers from Catalonia, who stay to Bhimpheedi for 4 months to supervise all the work and the different constructions. They work hard on a daily basis to ensure the antiseismical rules are applied.

The team of volunteers is coordinated by a general coordinator from Amics del Nepal who comes 3 times a year to Bhimpheedi and a technical coordinator from Base-A who comes once a year to Nepal. Bhimpheedi team is in constant touch with the two coordinators. Additionally, there is an advisor from UPC University, who comes once a year to Nepal and who is also available for any consultation or doubts. The advisor is an architect specialized in cooperation and post-disaster reconstruction, is the person who envisioned how the whole program had to be implemented in Bhimpheedi.



## 6. CONTINUITY OF THE PROGRAM

The program is supposed to continue after the first houses in Supin are finalized, but always depending on what all the involved entities decide. A meeting between all the parties will be held to decide whether there will be a continuation of the program to other communities or not. The program has also been transferring antiseismical knowledge to the people and now some of them are more empowered to build earthquake-resistant houses. In this regard, the program has already fulfilled most of its goals.

## 2. PROJECT DESCRIPTION AND BACKGROUND

### 2.1 PROGRAM BACKGROUND

After 2015 earthquakes, an intervention program was presented in Bhimphedi community after the village's request to our organization (Amics del Nepal). The earthquake had left 85% of the families without a home. Bhimphedi has a population of 6,321 inhabitants (official census of 2001, the last one carried out in the country), 3,166 men and 3,155 women; 88.8% of the population is devoted to agriculture, in most cases not paid.

All participant organizations in this program agree to understand that **BHIMPHEDI AWASUKA** is a **Technical Support Center for Habitat Improvement** created inside the AKKS Cooperative, coordinated by ADN and developed through the AWASUKA Program, by Amics del Nepal, Base-A, CCD-UPC and Rotary Club of Kantipur.

They also comprehend that Habitat -Aawaas- means the environment where a human being lives, which is made by physical factors (soil quality, safe houses, good quality water, healthy cooking...) and intangible relationships (better social organization, better hygiene, waste management...); and that AWASUKA will work to **convey all kinds of knowledge to foster habitat improvements** like: smoke-free kitchens, water treatment, hygiene diffusion, but being the main focus: earthquake resistant houses.

- **Program Name**

Awasuka Program: Habitat improvement and antiseismical reconstruction in Bimphedi, Nepal

Aawaas Sudhar Karyakram = Habitat Improvement Program

- **Location**

Country / District / Village: **Nepal / Makawanpur / Bhimphedi**

Address: Janajati Hall, **Bhimphedi Bazaar, Ward 2**

- **Duration**

Starting date: **July 2015** - Ending date: **November-December 2018**

## 2.2. LOCATION AND LOCAL CONTEXT

- **Country Background**

Nepal is an extremely underdeveloped country, it is considered one of the least developed and poorest countries in the world according to the UN report, despite the paradox of possessing a large untapped potential, for example in hydroelectric power, since it receives the great flow of the southern slope of the Himalayan mountain range. Part of the reason for this situation has to do with the socio-political and geographical environment.

Nepal is a very small country located between two giants: India and Tibet (China), from whom it depends on oil and energy supplies. On the other hand, a convulsive political situation in the country has influenced the economic slowdown and development, due to the recent decade of maoist insurgencies. Shortly after the earthquake, the government approved the new constitution, a great challenge that had been lingering for a long time due to the difficulties in satisfying all the political forces that represented the longings and hopes of the Nepalese people.

These and other factors have halted Nepal's development, which should have been growing in relation to the untapped potential of its natural environment; thus today, with 27 million inhabitants, Nepal has a poverty line of more than 40%.

- **Village Context (Bhimphedi)**

Bhimphedi is a municipality of 6,000 inhabitants located in the mid-mountain area or "siwali" (between 1500 and 2500m), at an altitude of 1150 meters and about 60 kilometers south of Kathmandu (the capital of Nepal). It is located in the Mahabarat mountain-range, at the bottom of a valley with two rivers, Lamo Khola on the north and Rapati Khola on the south. It is one of the historical communities of the Makwanpur district, in the Narayani area in the Central Nepal region. The capital of the district is Hetauda, located 20 km south of Bhimphedi.

Until 1956 this municipality was an important crossing point between the Kathmandu valley and India. After the construction of the Bhainse-Kathmandu road and its subsequent transfer to Hetauda of the district capital, Bhimphedi began a progressive decline as a commercial hub, while the economy of its inhabitants also fell, as well as the opportunities for development, already small in most of Nepal.

This situation also led the population to exploit the mountain in northeast of Mahabarat to use it as crops, to the detriment of the forest. The old thick forest full of flora and fauna has disappeared to give rise to areas of culture. Deforestation aggravates the problem of landslides, began in 1954 with monsoon rains, which caused some little villages to disappear, including the Ward of Dhorsing, and

affected severely road communications to Hetauda. Neither the local authorities nor the central government took initiatives to avoid this degradation of the ecosystem and create a sustainable outlet for the region.

Recently a new road communicating Kathmandu and Bhimphedi was inaugurated: it follows the path of the former walking path. The track is paved in almost all its way and it allows traveling from Kathmandu to Bhimphedi in less than three hours, as long as there is no heavy traffic or landslides. This road is pushing Bhimphedi to get back on track.

In Bhimphedi 80% of the population lives on very basic activities: unpaid agriculture and a very weak trade. Its inhabitants live in precarious conditions and have a fatalistic attitude towards adversity. Moreover, the population has another problem related to geographic and socio-economic situation of this district: the access to quality education. According to official data, 16% of children under 18 do not go to school, mainly because of the long distances separating their households from the school centers.

The local authorities and the central government of Nepal have not undertaken any planned initiatives to improve the economy of the area and to facilitate the education of its inhabitants.

- **The Earthquake in Bhimphedi**

An earthquake of 7.9 degrees on the Richter scale shook Nepal in April 25<sup>th</sup> 2015. Its epicenter was 150 kilometers west of Kathmandu. This earthquake has been considered the country's worst natural disaster since 1934: it caused more than 10,000 deaths. In the Bhimphedi community, 85% of its buildings were seriously affected. Fortunately, most of the population was outside their homes that day, that's why in Bhimphedi there were neither serious injuries nor deaths.

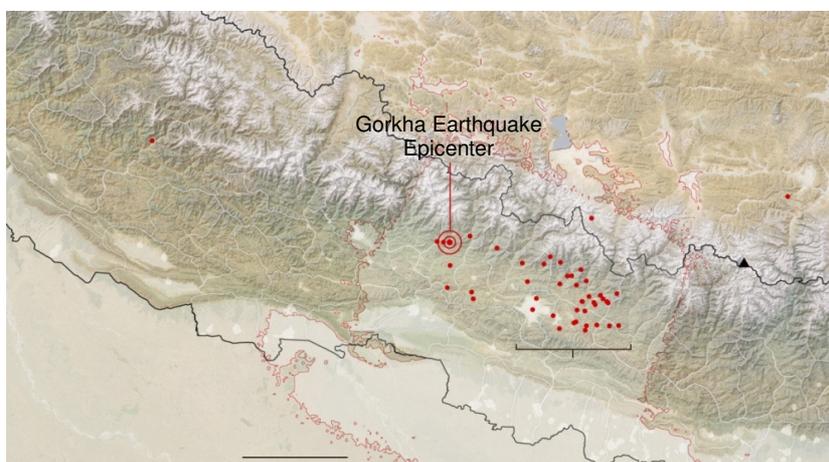


Figure 1: Bhimphedi in the middle of the epicenters of earthquake and aftershocks.

Bhimphedi was highly affected by the 2015 earthquakes, as shown in the following images. Former Bhimphedi VDC had 9 wards and 1110 registered homes, from which 30% were totally destroyed, 30% were damaged, and 40% remained intact.

The rural community of **Supin**, one of Bhimphedi VDC's former Wards, was the most affected one during the 2015 earthquakes. That's why the program will start in Suping area and from there it will replicate accordingly.

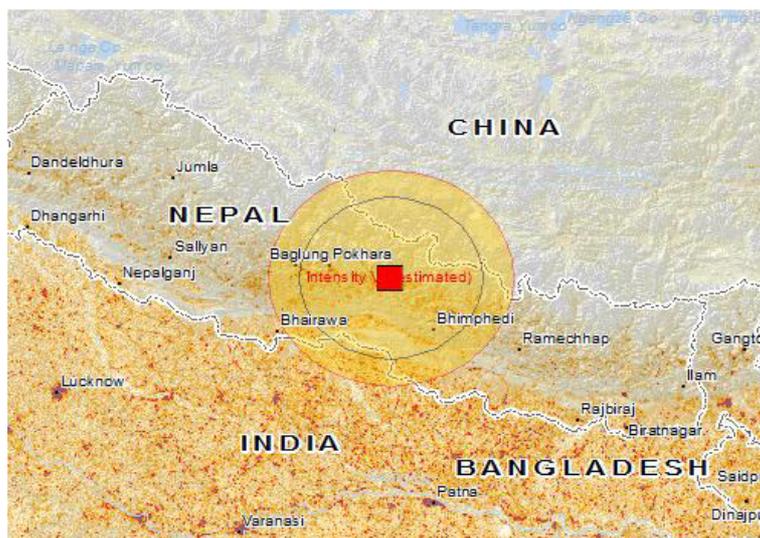


Figure: 2 Epicenter and action radius of the 7.9 degrees earthquake in Richter scale. Bhimphedi is inside the affected area.

### 2.3. PROGRAM SUMMARY

As previously mentioned, out of 1,100 registered houses in Bhimphedi, 200 were destroyed by the earthquakes, 600 were seriously damaged and only 300 remained intact. As a result of the large number of affected houses, Amics Del Nepal decided to start a program for habitat improvement in this village because these two reasons:

1. Amics del Nepal already knew Bhimphedi due to cooperation programs held in the village. Amics manages Bhimphedi Balmandir Children's Home since 2006 and has also managed several Community Development Programs in this village. This is the reason why, after the earthquake, Bhimphedi community requested technical help to Amics NGO.
2. After the 2015 earthquake Amics del Nepal had many NGOs contacting them to offer their technical help and collaboration on reconstruction in Nepal. These



entities were the above mentioned: BASE-A and CCD-UPC. Later on, Agragaami and Rotary Club also joined the team.

After many meetings amongst the different organisations, it was decided to start this program with an identification trip led by the three NGOs: Amics del Nepal, Base-A and CCD-UPC. During the trip many meetings with local private and public institutions took place, both at urban and rural levels. Additionally, more than sixty houses were visited, all in the different wards of Bhimpheedi, in order to study their damage degree, related to their construction typology. A detailed form was drafted from each and every visited house. Through their typology analysis some interesting findings on technical improvements were established. The visited homes were referenced and located in Google Maps, coded with a different color depending on its Seismical Damage Degree (SDD). After the trip, the technical team led by Pedro Lorenzo made a comprehensive report which established the basis of the program: contributing to improve the habitat of the population affected by earthquakes, both through their homes and their living conditions, in order to improve their response to new earthquakes. The program name is AWASUKA, after the Nepalese words Aawaas Sudhar Karyakram, meaning: Habitat Improvement Program.

The aim of AWASUKA is to improve two equally important aspects: social organization and building techniques. From the technical field, there will be two different lines of action: support in reconstruction and retrofitting. Different antiseismic technique tests will be developed, always using local materials and improved techniques; and contributing to the training of “mistris”, in correcting the inefficient use of traditional techniques. From the social organization, participative design workshops and social trainings will be held, to strengthen the population’s organizational capacity, management and decision making. This entails that the action to be taken does not involve a dependence of the population, but rather makes it active, having the knowledge to react positively to new earthquakes.

In Nepal, central government is acting in a logical way regarding reconstruction, but the true reality is translated into a lack of technical support in the remote areas. In rural local government, the organizational level is very poor: it is still based on family subsistence economy. Even though, the creation of local cooperatives is growing and this is strongly benefiting the development and the habitat improvements undertaken by the program.

In Bhimpheedi, the agricultural cooperative Agragaami will be in charge of hosting the **Technical Support Center for Habitat Improvement** called **Bhimpheedi AWASUKA**,

which will be coordinated by the entities participating in the Awasuka Program. This will provide technical support to all the villagers in Bhimpheedi, in close collaboration with the government.

## **2.4. CONSTRUCTION TECHNIQUES AND METHODOLOGY**

Many research activities have been conducted in the site before starting the practical tests. This has been an enormous amount of work, but with a very small visible impact. The site has been studied from various perspectives: technical bibliography existing in the country, current regulations, available local materials and dimensions; typical tools and traditional techniques, the site's geology, etc...

### **2.4.1. Confined Concrete Block Design**

The confined concrete block masonry technique used in this new model house is different than the ones proposed by the Government Catalogue in its 2<sup>nd</sup> Volume. The reasons for having chosen concrete block are: its **low cost** compared to wood or brick, its **fast execution** and the **higher need for improvements** in the current local techniques people are using in block construction.

Regarding the layout design, the houses must meet the needs of each and every family. Therefore, the house design is flexible and it provides different variations depending on the number of rooms and storeys. Spaces are adaptable. The most demanded houses have one floor, with one or two rooms and one verandah. Two storey houses with four rooms, verandah and optional corridor, are also demanded. According to the family needs the inner spaces can be adapted to different functions: usually all spaces are connected, but they can be partitioned if necessary. Upper storeys can either be used as rooms (chota) or for agricultural storage (buikal).

In addition, to contribute to a better thermal insulation, the CGI roof with insulated with bamboo canes. Optionally, the concrete blocks can be filled with vegetable fiber and thus become more insulating.

### **2.4.2. Construction Process**

Following, the different construction stages of the Confined Hollow Block Confined Masonry Model House are described:

- **Foundations**

Dig the trenches for mat foundations which will be built with stone masonry and concrete. Isolated foundations will be done with concrete. Excavation will always be done by hand, except in the case of finding the rock bed very close to the surface.



Vertical rebars for walls and pillars will be embedded in the mat foundations and will have concrete surrounding them thanks to a plastic pipe.

- **Plinth Beam**

Rebars and stirrups of the plinth beam will be laid on the mat foundations, leaving the vertical rebars go through it. Plinth beam will be concreted.

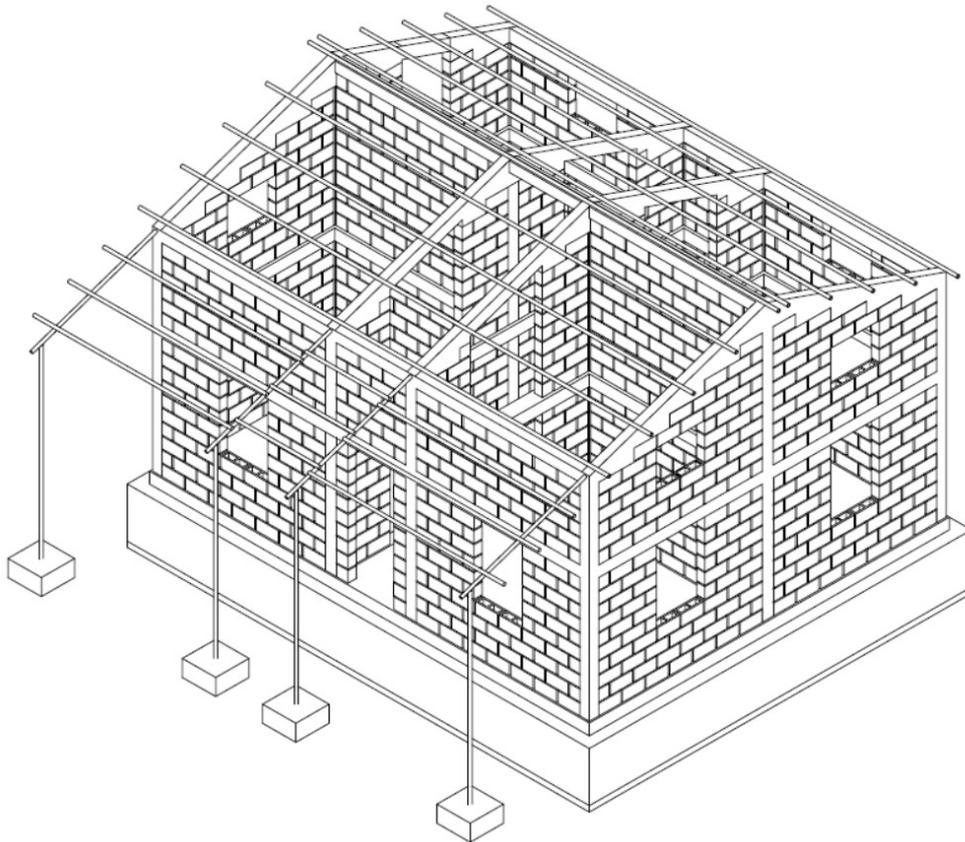


Figure 3: 3D view of confined masonry building

- **Concrete Block Walls (Ground Floor)**

The block walls will be constructed, putting a horizontal rebar every 2-3 block rows and concreting around the vertical rebars. The confining pillars will not be concreted until the walls reach the tie-beam level.

- **Concreting of Confining Pillars (Ground Floor)**

Once the walls have reached the tie-beam level, the confining pillars will be concreted using formwork on both sides of the walls.

- **Floor Tie-Beam**

After pillar-concreting, rebars and stirrups of the tie-beam will be laid on the walls, ready to be concreted.



- **Concrete Block Walls (First Floor)**

The block walls will be constructed, laying a horizontal rebar every 2-3 block rows and concreting around the vertical rebars. The confining pillars will not be concreted until the walls reach the roof tie-beam level.

- **Concreting of Confining Pillars (First Floor)**

Once the walls have reached the roof tie-beam level, the confining pillars will be concreted using formwork on both sides of the walls.

- **Roof Tie-Beam**

After pillar-concreting, rebars and stirrups of the tie-beam will be laid on the walls, ready to be concreted. This tie-beam will not be horizontal but inclined; hence, the concreting will be done in different stages to ensure the right inclination of the beam.

- **Roof Iron Structure**

Round iron-pipe purlins will be fixed to the roof tie-beams in order to form the roof structure. For the verandah structure, iron-pipe rafters will be fixed to the roof tie-beam in one side and on the verandah's posts on the other. Then, round iron-pipe purlins will be fixed on the rafters. All connections will be made with angles and bolts, to avoid welding. (Welding staff is hard to find in remote areas, that's why it is avoided as much as possible).

- **Roof Finishing CGI Sheet**

The roof finishing in house and verandah will be CGI sheets. They will be fixed on the purlins with the traditional U-bolts. Thermal insulation will be ensured with bamboo rods placed at the purlins' level, before the fixing of the CGI sheets takes place.

## **1.2. PROGRAM VIABILITY AND ENVIROMENTAL IMPACT**

### **1.6.1 Socio-Cultural Viability**

- **Adaptation to socio-cultural factors in the area**

The program arises from the identification of needs for habitat improvement expressed by the population of Bhimpheedi. In addition, the people participate voluntarily in the construction of their houses to learn about anti-seismical techniques. Moreover, awareness talks and practical lectures are held in Awasuka office to convey knowledge and increase motivation.

- **Actions in the most vulnerable population**

The program aims to reach the most needed population. The goal is to improve the community's resilience and encourage the women's involvement, so that they will be aware of the new techniques and thus will be able to spread them later.

- **Collaboration with local authorities**

The local government has given its approval to the program, given the possibility of complementation between the AWASUKA program and the government's government aids. A future collaboration is expected when Awasuka Design is submitted to the government, in order to receive NRA approval.

### **1.6.2 Technical Viability**

Houses are made using local technologies and adding anti-seismic improvements to traditional techniques, such as diagonal bracings. In all cases the workforce is local people trained in earthquake-resistant improvements; this yields a win-win relationship, as the locals always have improvement suggestions on their side and hence the construction process is improved from both sides.

### **1.6.3 Environmental Impact and Sustainability**

Buildings will be built using local materials, therefore the impact on transportation is minimal and the CO<sub>2</sub> emissions will be minimized during the construction process. In addition, most materials are sustainable and, in some cases, reusable: clay, sand, gravel, wood. The only materials coming from Hetauda will be cement, concrete blocks and iron sheets.

As secondary environmental objectives, several actions and activities are being performed to solve other habitat problems: workshops and awareness programs to raise awareness for water treatment, improvement of the latrine's design and functioning, and dissemination of chimney construction to achieve healthier and safe cooking.