CONFINED STONE WALL (CSW)

A sustainable option for a better and safer reconstruction in rural Nepal

TRIBHUVAN UNIVERSITY
Kathmandu , Nepal
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Architecture & Développement

- International NGO based in Paris
- 20 years of experience
- Over 100 projects on 4 continents
- Core group of senior experts
- Task force of volunteers

Competences:
Technical expertise, advisory, design & project management, participatory construction, hands-on trainings, supervision, monitoring and evaluation.

Mission statement

- To create processes compatible with a holistic & sustainable approach, taking into account social, economic and environmental concerns
- To improve the quality of the built environment in emergency, post emergency and development contexts
- To promote the social role of professionals in the construction sector

CSW program background

Pakistan (2005) : First idea after the Batagram earthquake

Morocco (2010-2012) : 4 prototype modules in 2 locations

Haiti (2012-2013) : Post disaster reconstruction - 60 houses + income generation program

Morocco (2015 – 2017) : thermal and cost efficiency water/sanitation, class room

Nepal (2016 – 2017) : demo house + seismic tests

Post disaster Social Center for women and children (Morocco, 2011)

Pre- school in the desert (Morocco, 2012)

Post disaster rural housing scheme (HAITI, 2013)

Model units in a eco friendly campus (Morocco, 2015)

CONFINED STONE WALL (CSW)

STONES

+

WIRE MESH CAGES

+

MUD PLASTER

=

A SAFE AND PERMANENT BUILDING

PHASE 1 : FOUNDATIONS

No specific foundations: the structure sets on a layer of **burried CSW** that can be protected with a waterproof and anti-termite barrier.
This allows for building in **a diversity of sites**, even on unstable soils.

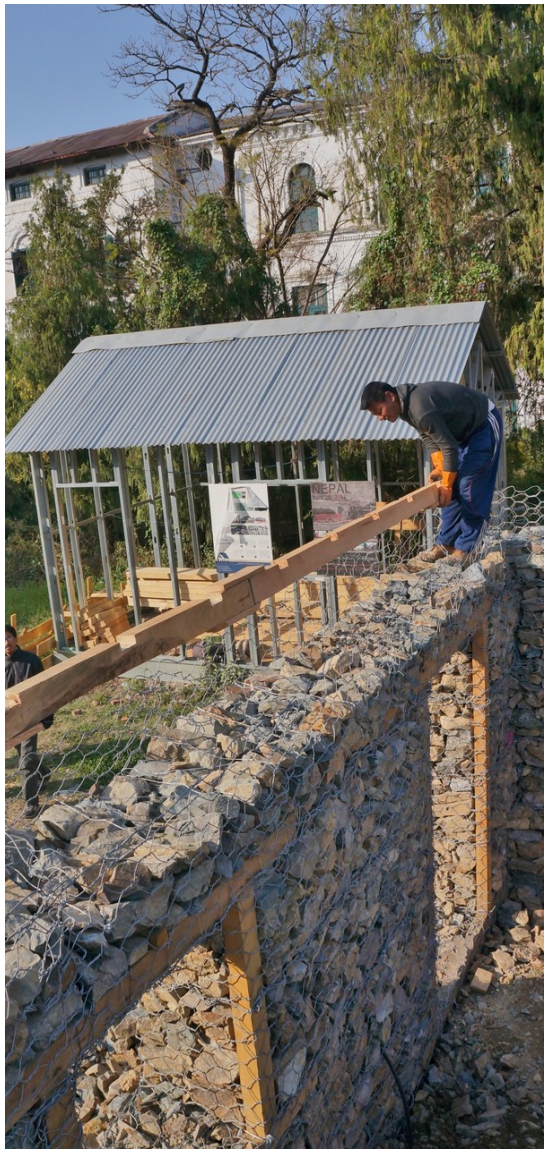
PHASE 2 : WALLING

The **cages are manufactured on site** in a workshop equipped with a table for weaving hot galvanised steel wire.
Walls are built continuously by piling up wire cages and filling them with raw stones.

PHASE 3 : OPENINGS

A **first frame** is placed into the CSW wall for each opening. A secondary frame is then inserted to attach doors and windows openings.

PHASE 4 : FLOORING



The flooring structure is placed on a **wooden tie band**, embedded into the upper row of cages.

Joist are stiffened with spacers. They bind all the floor together with the bearing wall and create a **diaphragm structure** (action box)

PHASE 5 : ROOFING

CSW allows for **many types of roofing structures** and can be adapted to **locally available or recycled materials.**
Trusses are designed to connect to the floor and allow more habitable space

PHASE IV : PLASTERING

Walls are **plastered on both sides** to protect the wiremesh and isolate from humidity, cold and insects.
The plaster composition is adapted to **available material** and vernacular building practices.

SIMPLE TO IMPLEMENT

Dry technique (no water, no cement)

No need for **complex tools**

Participatory construction with **unskilled labour.**

Building process that reduce **errors in workmanship.**

ADAPTABILITY

Simplicity, modularity and **efficiency** allow for diversity of geographic contexts

Typology flexibility (distribution of modules and partitions as needed)

Adapted to rural or suburban areas, for **individual housing** or for small **community facilities**

Formal diversity that respects **vernacular** architecture

Suitable for **backward areas** (social-economic isolation, logistic difficulties, technical precariousness)

SOCIO-ECONOMIC IMPACT

Construction performance
Recycled and local materials, sound technology, no mechanisation, easy monitoring

Owner driven process
High in-kind contribution of beneficiaries : Stone collection, cage manufacturing, filling and assembling of components

Social and economic insertion
Local production/supply chain, income generation programmes

Community dynamics
Participatory project, housing cooperatives, easy replication, familiar technology

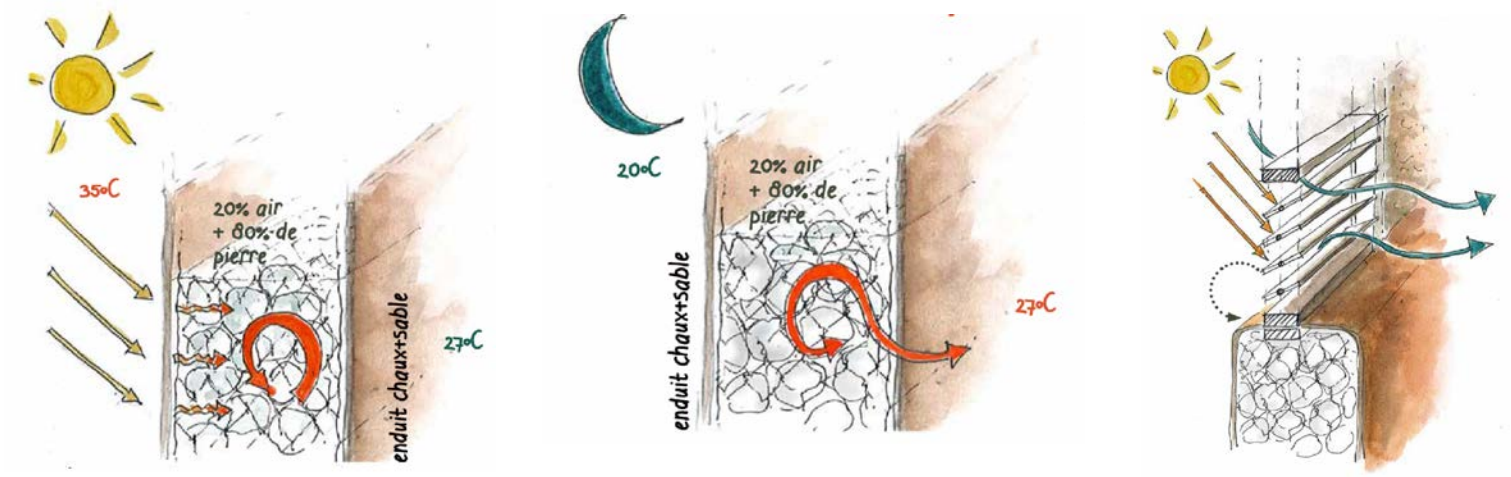
Cost efficiency
Lox cost material, high intensive labour, non contractors or middle-men

BIOCLIMATIC FEATURES

Added value of locally available materials
Rocks, earth, lime,

Energy efficiency
High thermal capacity, passive solar conception, reduced need for heating.
Reduction of energy precariousness, increased comfort

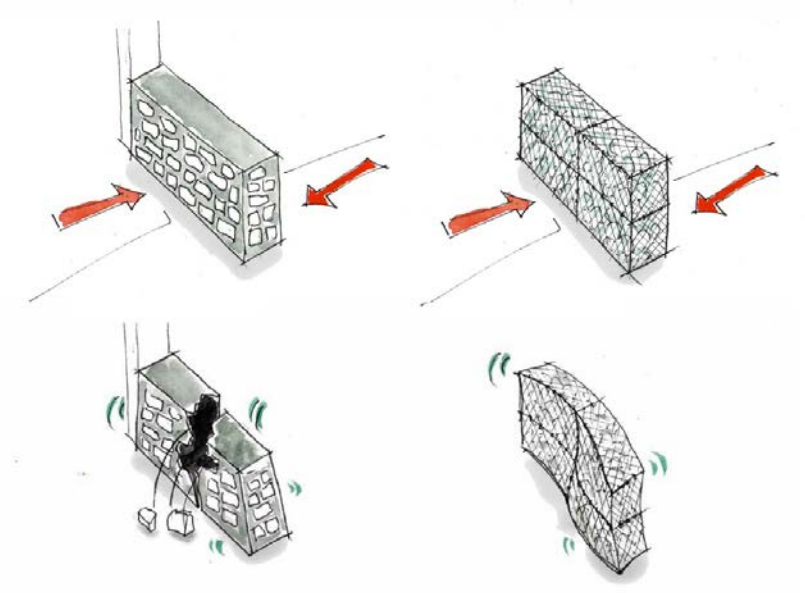
Low environmental footprint
Recycled material, low grey energy, limited CO^2 emissions



CSW has a large thermal inertia and a resistance of around 0,60 m².K/W
(equivalent to brick wall + 10cm styrofoam panel)

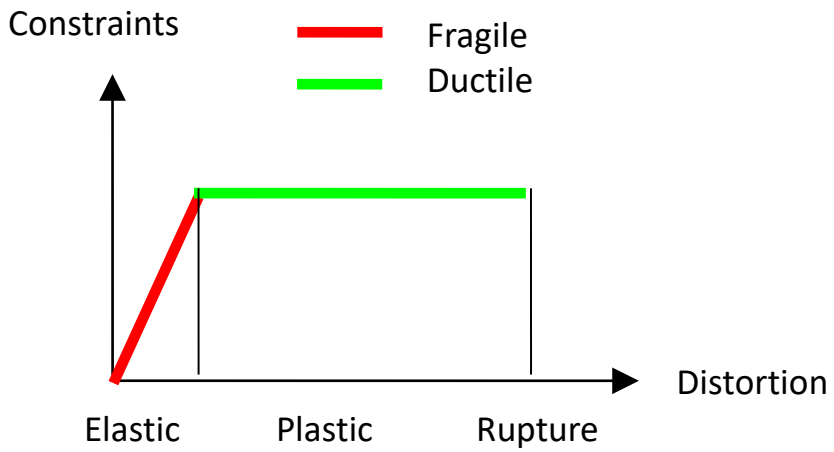
SEISMIC PERFORMANCE

CSW achieves static and dynamic structural integrity with **interrelated concepts** of architectural design (**action box**) and CSW absorption/. properties (energy dissipation by friction).



Masonry wall

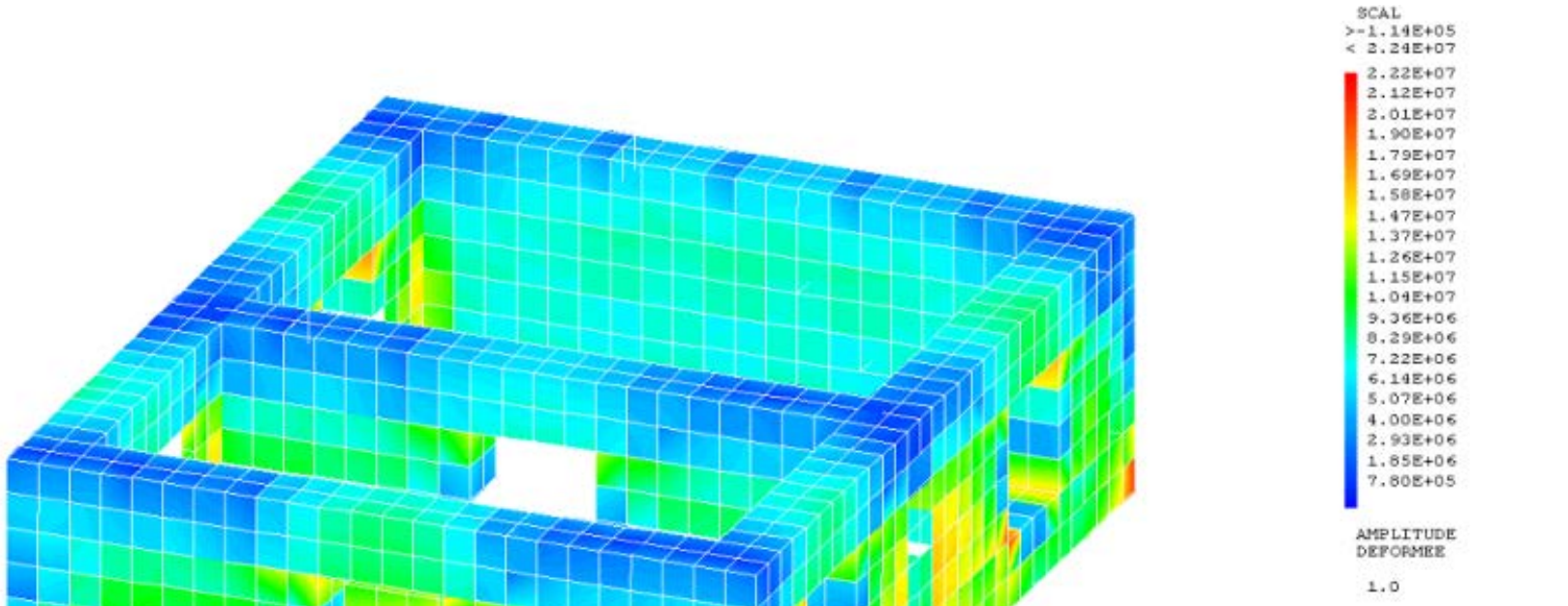
Confined Stone Wall



CSW technology combines the **hardness** from stones and the **ductility** of steel. The result in a seismic context is at first **rigidity** and then **plasticity.**

SEISMIC BEHAVIOUR

Initial studies show CSW system can withstand high seismic activity, yet **further studies are needed to certify the properties**



Numeric Finite Elements Modelisation with Cast 3M calculation code from CEA (Commissariat Energie Atomique, France)

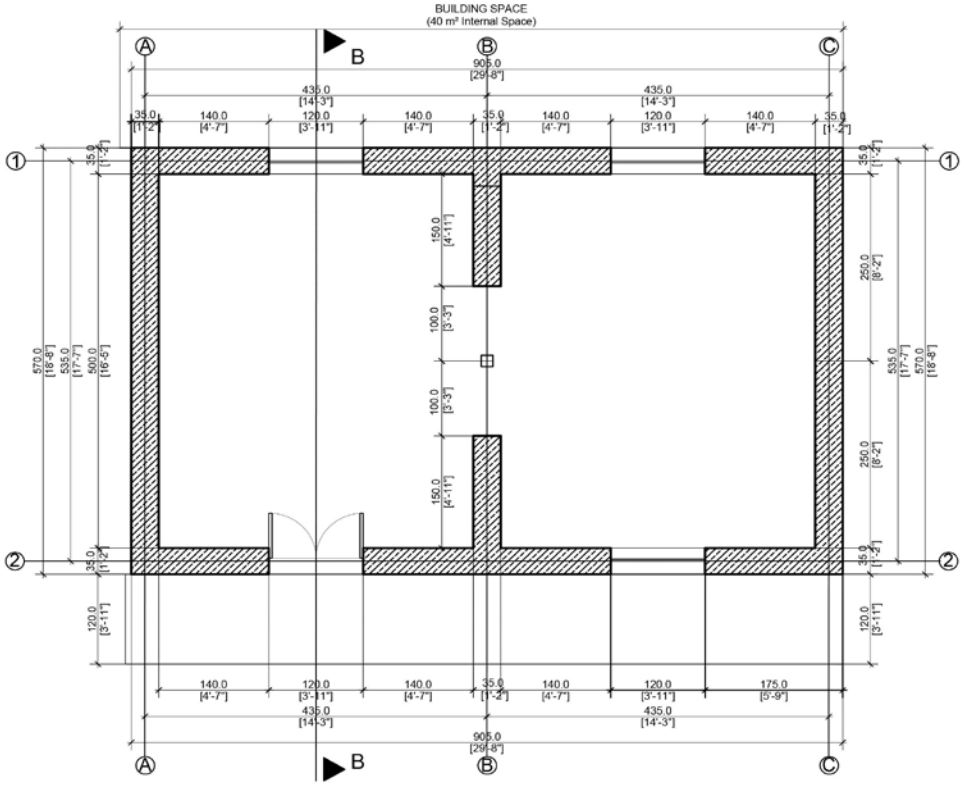
Nepal 2016 – 2017 : CSW as an alternative for owner driven reconstruction ?

- Demonstration unit with TU
- Extended tests
- Compliance with Building Code and DUDBC standards

Academic / Corporate / NGO partnership

- Dissemination
- Pilot projects
- Hands-on trainings
- Income generation activities (wire mesh)

CSW HOUSE: Proposal for DUDBC



Facades

Layout

This model is under process of approval, dimensions and specifications are merely informative

THE CSW PROGRAM IN NEPAL

Designed and implemented by :

ARCHITECTURE & DEVELOPPEMENT
ASSOCIATION DE SOLIDARITE INTERNATIONALE

In Partnership with :

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Thank you!

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