

Rehabilitation of hand-dug wells: diagnostic and technical solutions

Introduction

Within the frame of its maintenance projects conducted in Sierra Leone, Inter Aide was rapidly confronted to a high demand for rehabilitation of hand-dug wells, beyond the sole issue of the pump maintenance. In this direction, the following tool was designed to propose practical advices for the rehabilitation of hand-dug wells.

Starting from practical cases observed on the field, the idea was to break down different steps of a diagnostic of a well in order to setup a protocol and to help appropriate decision-making as regard technical solutions. Of course, the major question in the background remains the relevance to rehabilitate an existing well versus the construction of a new well. Indeed, in some cases, the rehabilitation may appear inappropriate because it is too costly as compared to a new construction, or too risky or because of a too low feasibility to restore the well in a correct state.

Presentation of the tool

Starting from a decision-making tree, the tool proposes 6 explanatory cards to be used following the situation observed during the diagnostic of the water point (gray boxes - slide 1):

- Diagnostic decisional tree
- Card 1: Questions to be considered before starting
- Card 2: Security first!
- Card 3: Rehabilitation of the surface work
- Card 4: Rehabilitating the lining
- Card 5: Rehabilitating the casing
- Card 6: Rehabilitation tools

A last slide presents a reference scheme of a hand-dug well and a borehole.

Card 1: Questions to be considered before starting

Open the **access cover** (if it is a sealed concrete cover, you need to break the concrete joint)

What is the level of the **water column in April/May?**

More than 1,5m

Less than 1m

Is there a **cover slab and a hand-pump?**

Yes

No

Is the pump working perfectly?

Yes

No

Is the **pump stand** perfectly vertical?

Yes

No

Is the cover slab in good condition?

No

Yes

We can concentrate on the **rehabilitation of the surface work**

Card 3: Surface work rehabilitation

Hand-pump repair. Check first if the pump is correctly installed (especially if there are enough pipes)

Break the concrete joint, straighten up the cover slab (in order to have the hand-pump perfectly vertical) and make a new concrete joint

Break the old cover slab and cast a new one

Card 2: Security behaviours

Quick assessment of the **internal condition**

Good / middle condition

Very bad condition

Remove the **cover slab** (card 3)

Rock survey: is it rock free?

No

Yes

Is there any **caving?** (On the bottom lining, behind the original casing)

No

Yes

Card 6: rehabilitation tools

NOT POSSIBLE

Lining rehabilitation if necessary

Card 4: Lining rehabilitation

Is the **casing** good enough to support additional ones?

Yes

No

Card 5: Casing rehabilitation

cast a **special size casing** Inside the old one

The **water reduce** just at the end of April / Mai? (= you need to wait to fetch water but the well is not completely dry)

No

Yes

normal casing on the top of the existing one

We can consider a minimum of 3 casing until 100 people.
One casing more each 100 people =
200 p. → 4 casing
300 p. → 5 casing

Card 1: Questions to be considered before starting

Question	Purpose
When was it done?	To know if it is an old construction (which usually needs more rehabilitation)
By whom?	To know the “construction strategy”: every actor has its own methodology and particularities. Also, the quality of the intervention may vary from one actor to another, and specific particularities can be observed depending on the operator.
On which month the operator finished the casing/sinking?	To know if they complete the well before, during or after the rainy season. If the well was not completed in April/May, the risk of facing water availability problems is high.
How many casing did the operator cast?	To calculate how many casing were sunk (comparing to the number of casings observable from the access cover)
Background of the pump status	To know if it is broken since a long time (it can be a bad installation: not enough pipes, pump stand not straight, clay that is immobilizing the cylinder) or if it is just a matter of maintenance

Key elements to take into account to decide to do or not a rehabilitation:

1. Security:

if you think that it is not safe to work inside this well, it is better not to do it (major risk: mould or concrete collapsing)

2. Cost of the rehabilitation versus a new construction

Take into account the well deepness, the construction you have to break (before starting the intervention) and the construction you have to do

→ It it too much time spending?

→ Is it too complicate? Or you feel not comfortable to do it?

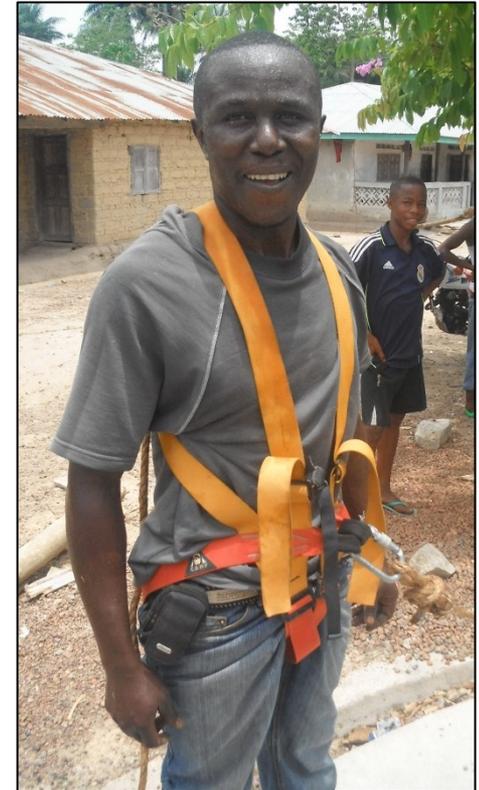
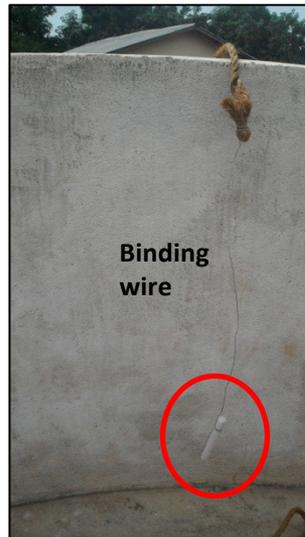
Card 2: Security first!

Before going down into the well

1. Open the access cover
2. Leave it open for 4-5 days
3. Make some air circulating by moving up and down a branch linked to a rope



4. Make the **candle test** (as you see in the picture you tie a candle to a rope and you put it down lighted into the well: if the light goes off, it means there is not enough oxygen, you need to wait)



Rescue rope: in case the person has a problem this rope is used to rescue the siteforeman

Main rope: it is used to lower (and bring out) the siteforeman inside the well

Safety rope: the siteformane uses this rope as support to go down and to come up



a. Be sure that the body harness is strong enough

b. Take your time to explain to the team what you are going to do

c. Explain clearly to the team what they have to do: each one must have a **clear understanding of his role**

d. Explain clearly who is going to give the instruction (**just one person!**)

Card 3: Rehabilitation of the surface work

Before starting any intervention, be sure that the site is **well fenced and organised**



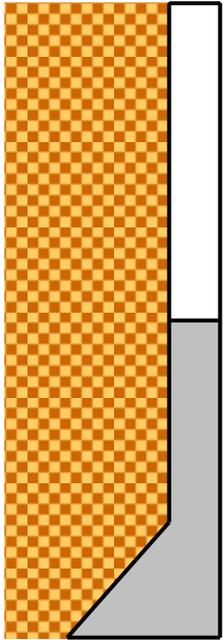
If the surface work was done with **no reinforcement** (soak away pit on the top) or with a **poor mixture** (apron on the right), after few months, several cracks will progressively appear.
→ If the damages are minor, a simple plastering is enough.
→ Otherwise, it is necessary to break everything and redo the surface work.

Cover slab rehabilitation

- ✓ Break the concrete joint
- ✓ Use some sticks to lift it
- ✓ You can also use a rope handled to the pump stand to assist
- ✓ Break the concrete
- ✓ If the reinforcement was well done, you can use it again

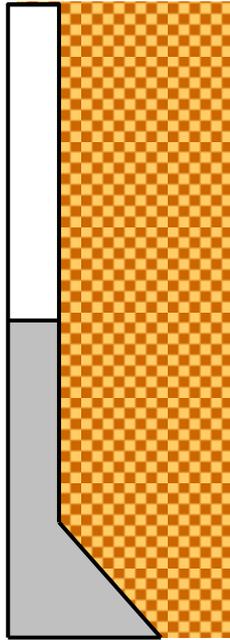


Card 4: Rehabilitating the lining



1. Lining with anchorage

→ Essential to avoid any lining movement



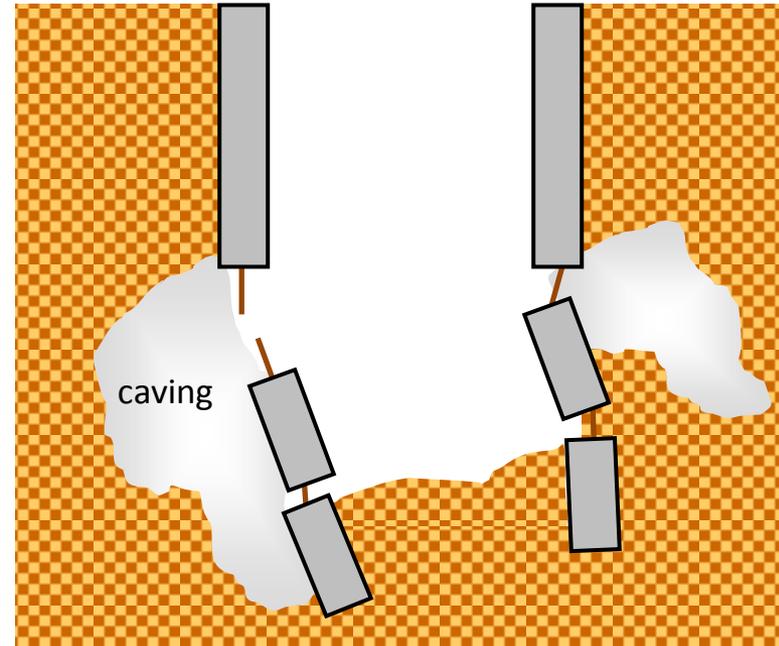
Assessment:

Minor problem. With the age, the concrete may start to have some cracks. Some iron rods can then be exposed.

Rehabilitation:

The concrete needs some plastering (especially to cover the iron rods that are exposed)

Easy rehabilitation



2. Lining without anchorage

- Possible movements, especially in the first lining if it is in contact with water
- The lining starts to break and soil collapse behind (caving)

Assessment:

- Some lining rings are completely damaged
- Deep caving observable

Rehabilitation:

→ feel the holes as much as possible with stones and seal it with concrete

It is necessary to evaluate if there is any risk of collapsing. If it is the case the REHABILITATION is too dangerous and SHOULD NOT BE DONE.



Card 5: Rehabilitating the casing

The original casing is in very bad condition: it cannot support a new construction

Case a:

- Original casing too difficult to break OR
- There is caving behind (risk of collapsing) OR
- There is just the need to add just 1 or 2 casing, → It is better to make a **special casing** (smaller size)

SPECIAL CASING is MORE SAFE and avoids any risks of collapsing

Case b:

The sediments behind the lining fall into the well and cover the original casing.

→ In this case, first of all it is necessary to rehabilitate the lining (to avoid any collapsing) and then to dig until the casing, break it and build up a new one

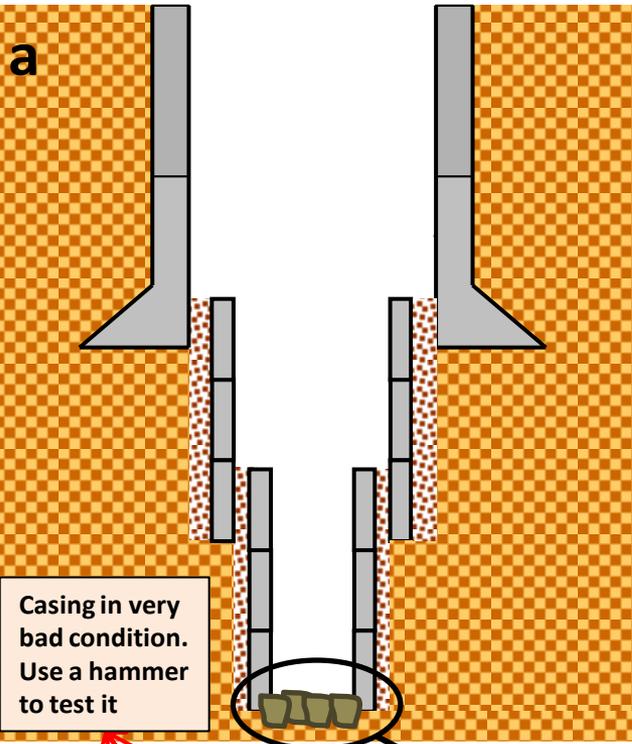
You must decide whether it is relevant (and safe) to make all this work, or if it is better to dig a new well.

Case c:

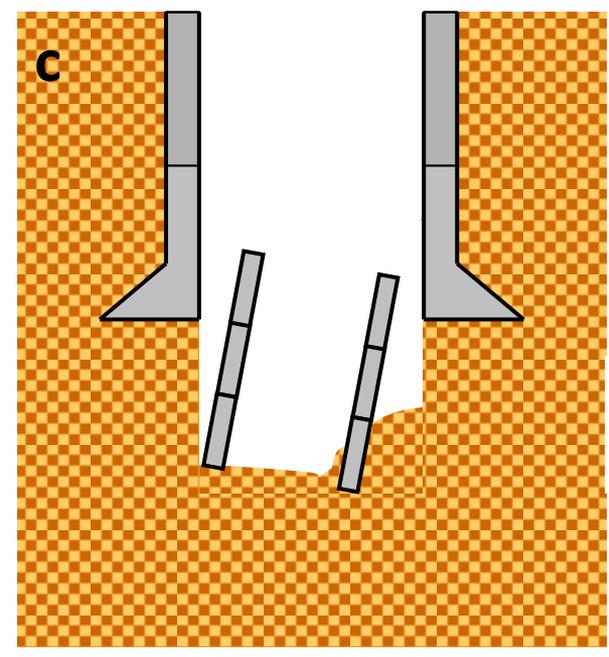
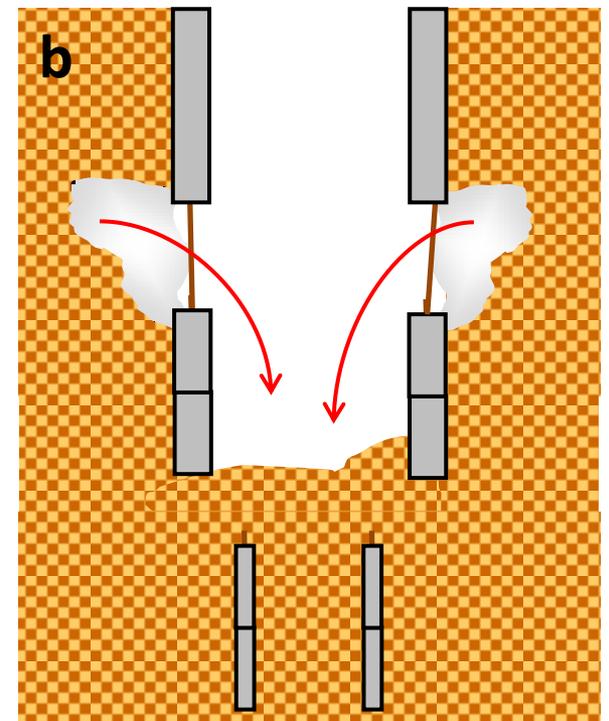
The casing is not perfectly straight .

→ If it is in bad condition: it needs to be broken (**risk of collapsing behind**).

→ If it is in good condition: dig at the bottom and use at least 8 spacers to assist it going down perfectly straight



Put stones at the bottom: to avoid any clay to come into the well
 → Risk of pump breakdown and clogging
 → Reduction of the water column



Card 6: Rehabilitation tools



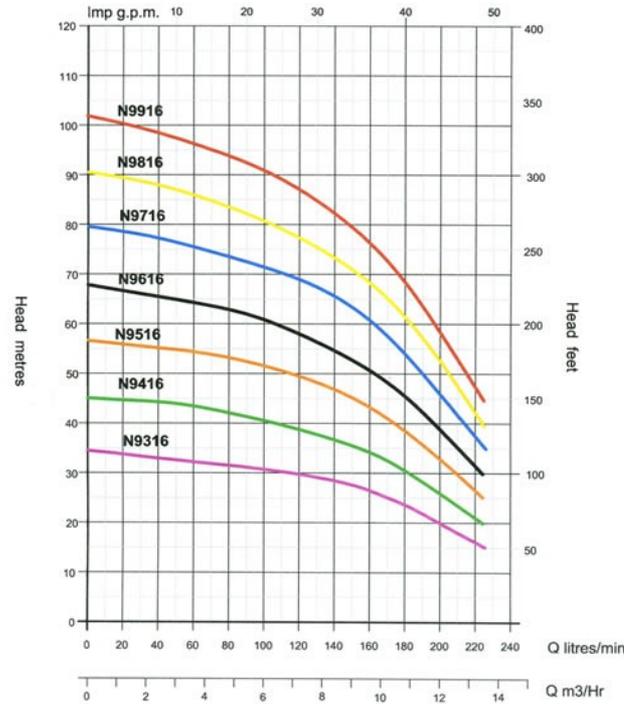
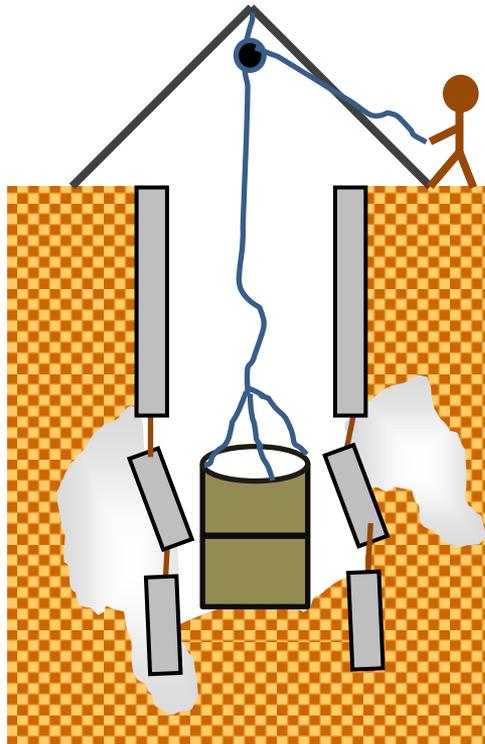
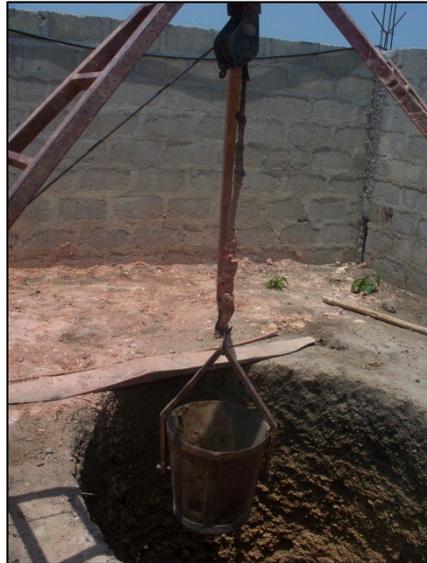
Tripod (locally made)

- Useful to cast the casings outside (0,5 meter to have less weight)
- It is possible to work even if there is some water inside the well (as the curing is done outside)
- It is possible to work in rainy season

[possibility to look for the imported tripod: ask to the Lunsar vocational center]

Why to cast the casing outside?

- For rehabilitations with collapsing risks, it is safer
- To spend less time inside the well
- The casing protects from the collapsing behind



Dewatering pump

The chart at left indicates the pump to be chosen based on the yield: The different lines correspond to different models. Usually, at 15m deep, we need a machine that can pump about 50 l/min

→ A pump allows working when there is water inside the well, and being more efficient in sinking the casings



Giant curter → to cut the iron rod of the lining / casing that needs to be broken



Special casing

Out to out 120 cm
In to in 100 cm

