



Supervision

Stone Arch Bridges

Belgian development agency

enabel.be



Construction - timeline

- Between 1 and 4 months
- Factors for delay
 1. Local contribution
 2. Heavy rainfall
 3. Local leadership change
 4. Small pool of experienced masons
 5. Accessibility roads





Stone masonry

Materials

Mortar

Method

Preparation

After works

- Quality of materials
 - Size of the trips delivered
- Stones
 - Size of the stones
 - Shape of the stones
 - Strength of the stones
- Sand
 - Cleanness of sand
 - Silk/clay content sand
 - Storage of sand



Stone masonry

Materials

Mortar

Method

Preparation

After works

- Quality materials
- Mix well
 - Uniform, 1 colour
- Ratio
 - Cement:sand – 1:3
 - Ratio water:dry materials



! More water: easier to work, bad for quality

- Avoid spilling mortar
- Reuse mortar





Stone masonry

Materials

Mortar

Method

Preparation

After works





Stone masonry

Materials

Mortar

Method

Preparation

After works

- Correct selection for correct purpose





Stone masonry

Materials

Mortar

Method

Preparation

After works

- No air gaps
- Right shapes to fit
 - Put small stones in between
 - Fill gaps with mortar





Stone masonry

Materials

Mortar

Method

Preparation

After works

- Horizontal
- Corner stones





Stone masonry

Materials

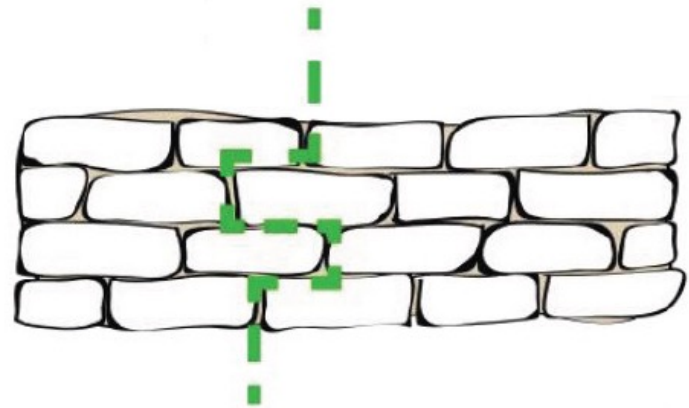
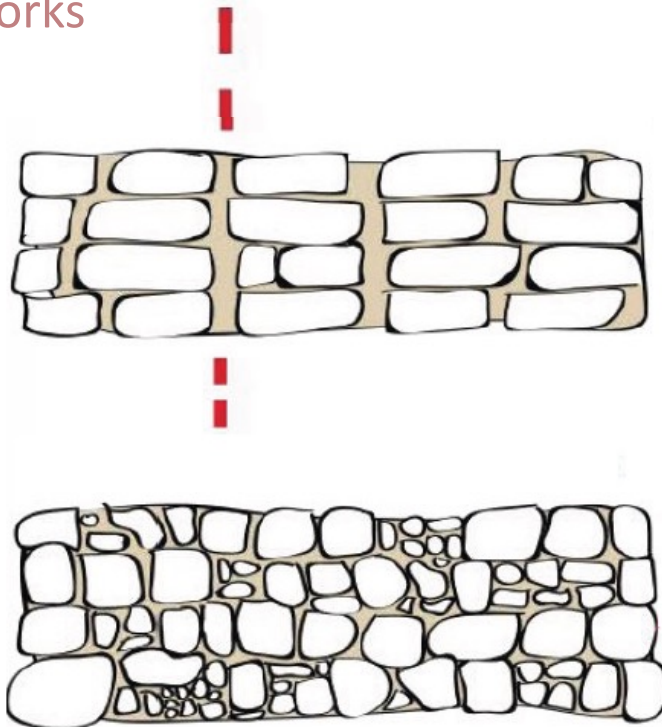
Mortar

Method

Preparation

After works

- Stacking with overlap





Stone masonry

Materials

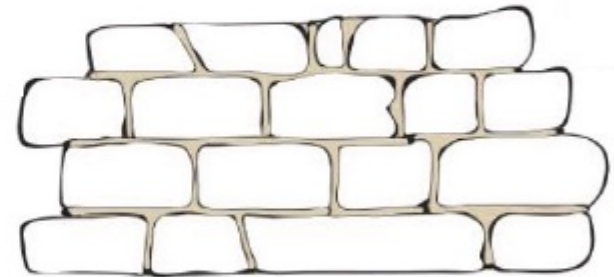
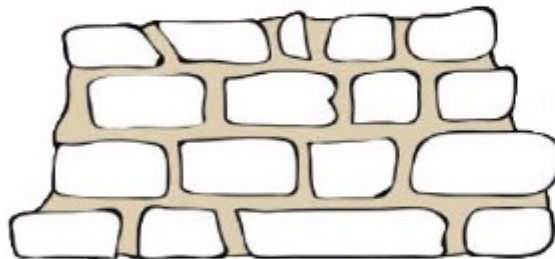
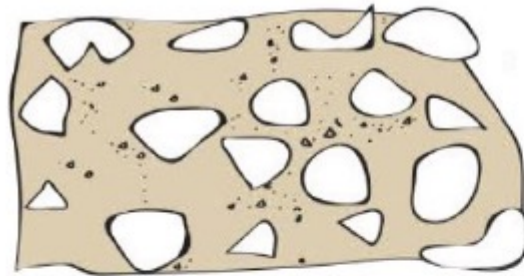
Mortar

Method

Preparation

After works

- Mortar thickness





Stone masonry

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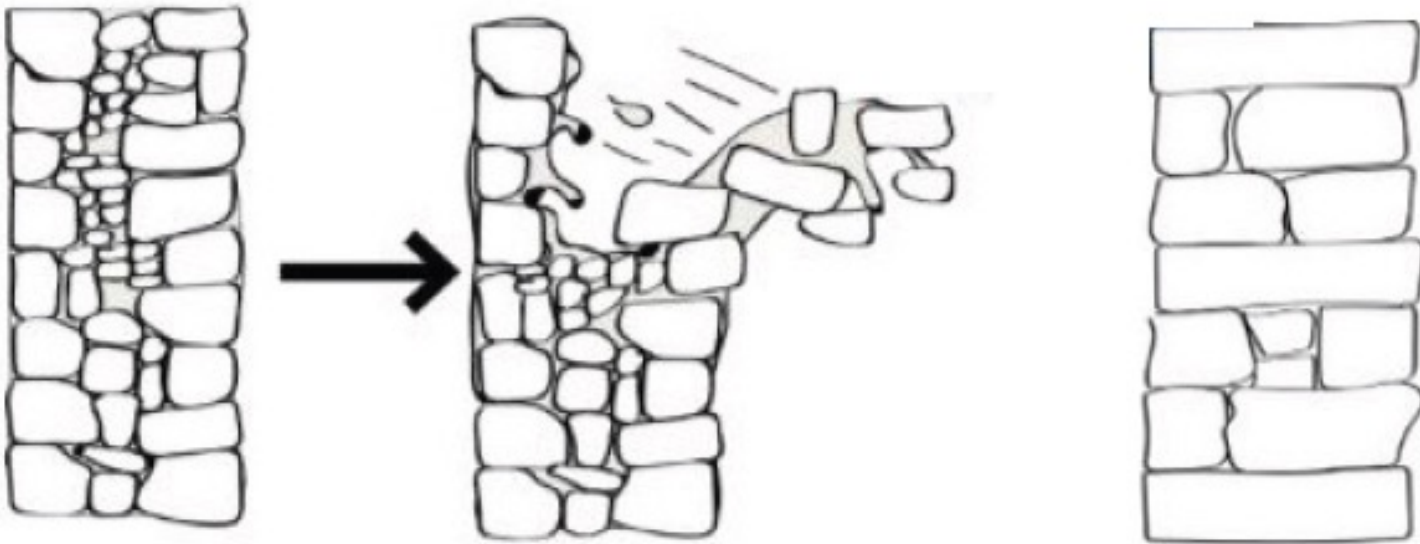
Mortar

Method

Preparation

After works

- Tie stones





Stone masonry

Materials

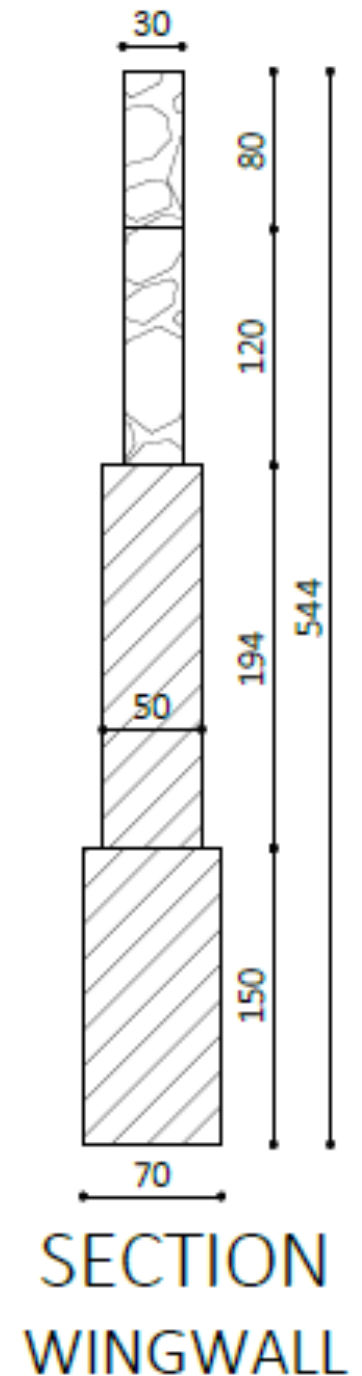
Mortar

Method

Preparation

After works

- Thickness to height





Stone masonry

Materials

Mortar

Method

Preparation

After works

- Stones
 - Wash before use
 - Keep clean until use
 - Make wet before placing in masonry
- Mortar ready in karai
- Clean surface where works will start
- Water bottle next to works





Stone masonry

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Mortar

Method

Preparation

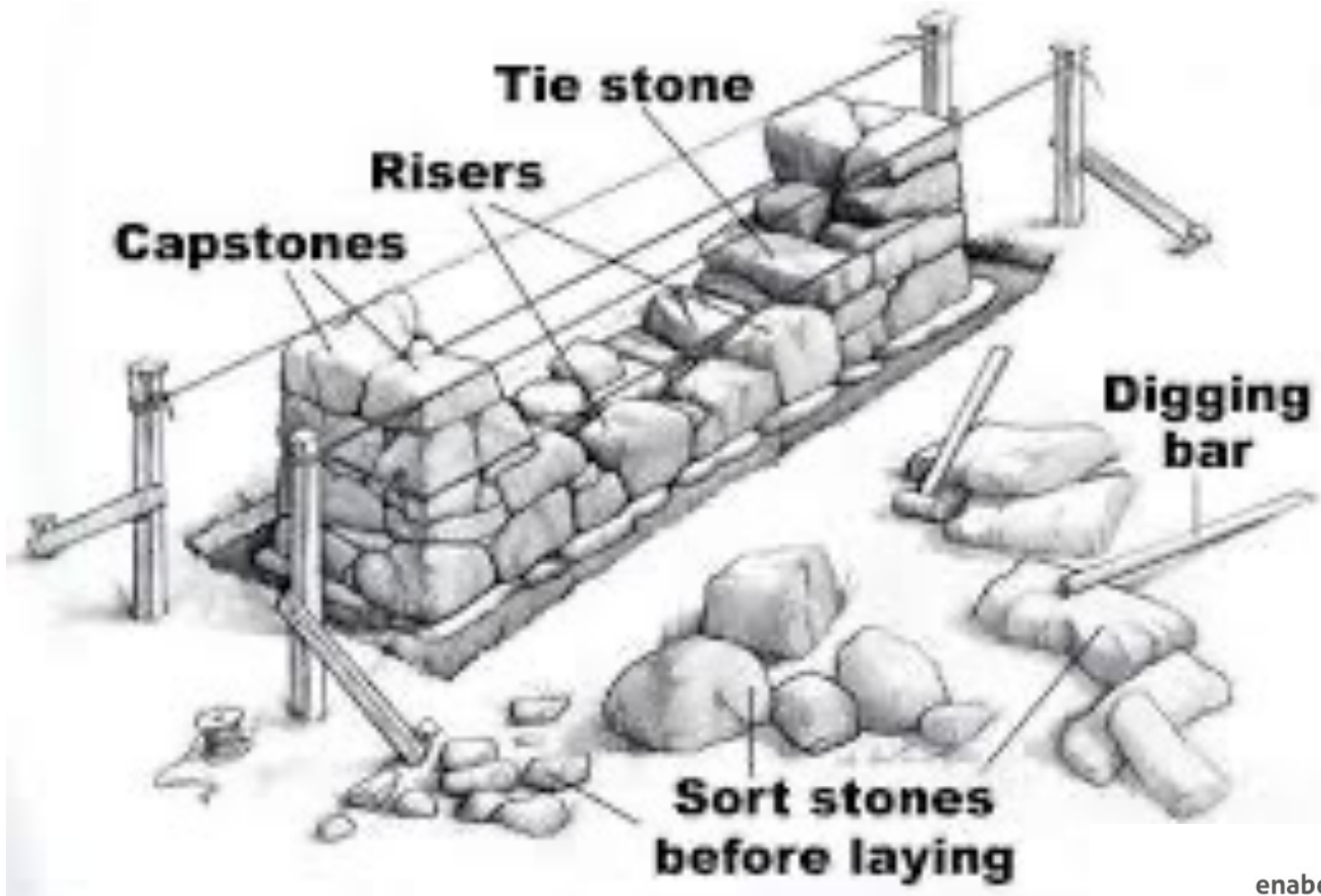
After works

- Don't walk on fresh masonry
 - Scaffolding
- Keep masonry damp for curing
 - Cover with grasses, ...
- Protect fresh masonry from rain





Stone masonry





Stone masonry

Site Instruction Ledger

Construction long stone arch bridge –

Date											
Construction stage:											
People present:											
Quality stone masonry											
No air gaps	yes	no	Good bond	yes	no	Stones clean	yes	no			
Large stones	yes	no	Rough surface	yes	no	Mortar recycled	yes	no			
Proper corner stones	yes	no	Right mix	yes	no	Watering curing	yes	no			
Ledgers are updated:			cement	yes	no	sand	yes	no	stones	yes	no
Instructions to mason											



Supervision per element

Setting out

Foundations

Formwork

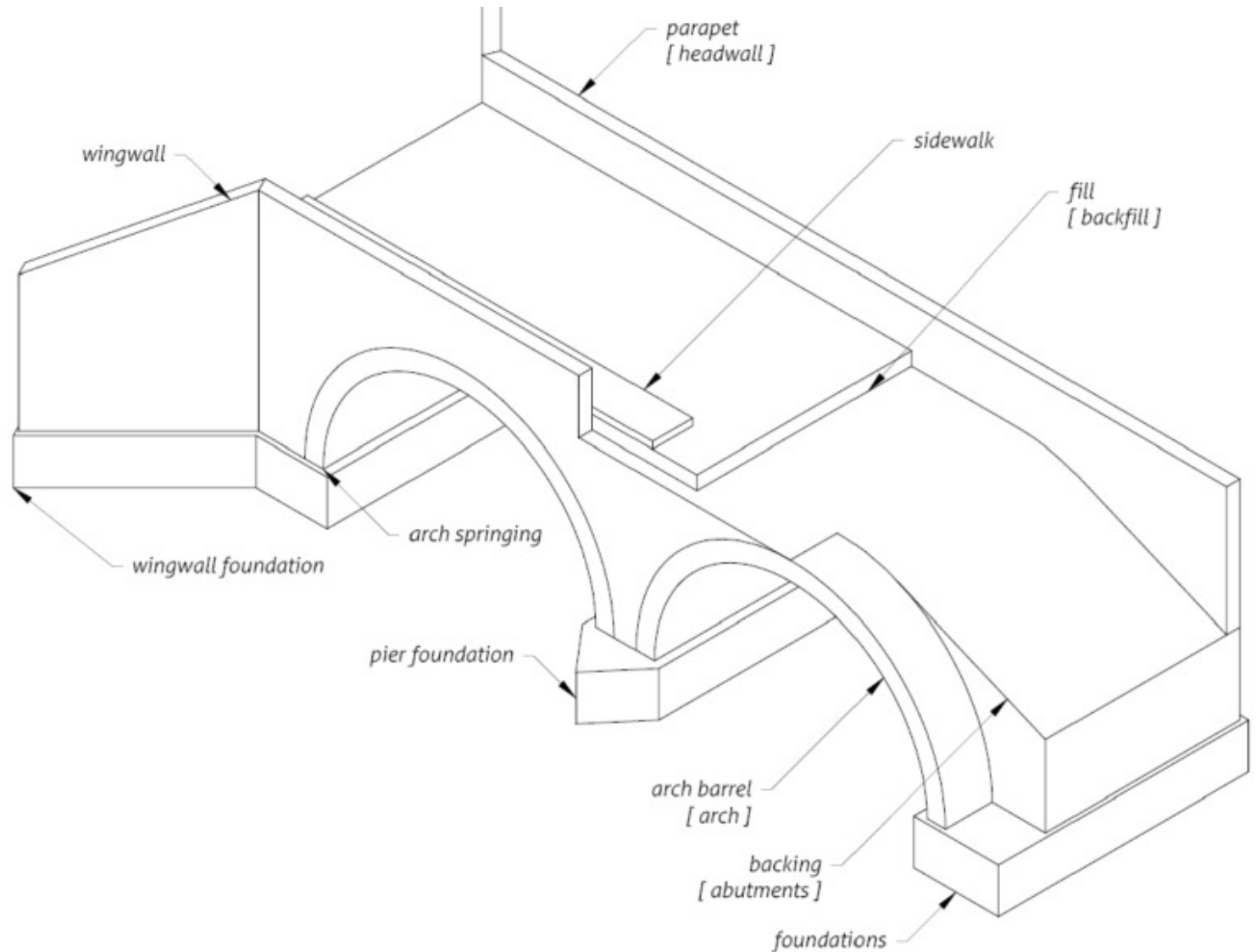
Arch

Abutments

Wingwalls

Headwalls

Deck





Supervision per element

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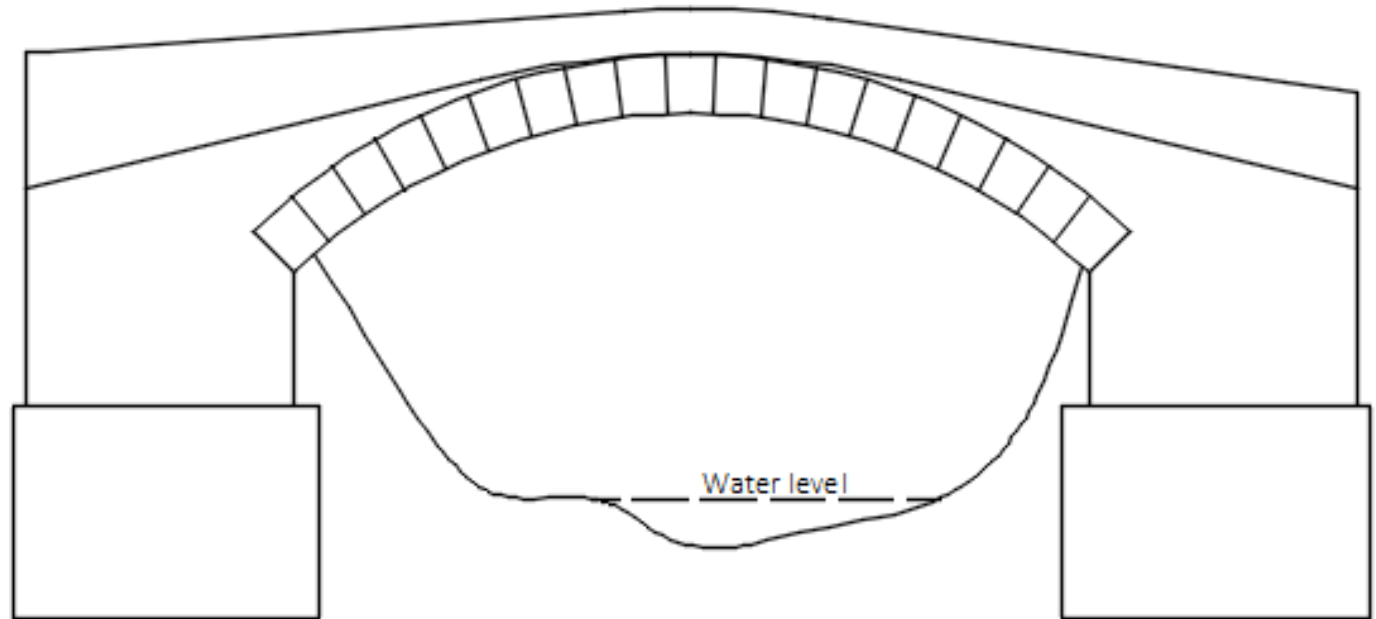
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Setting out

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Setting out

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Setting out

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Setting out **Foundations**

Formwork

Arch

Abutments

Wingwalls

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Deck





Setting out **Foundations**

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Arch

Abutments

Wingwalls

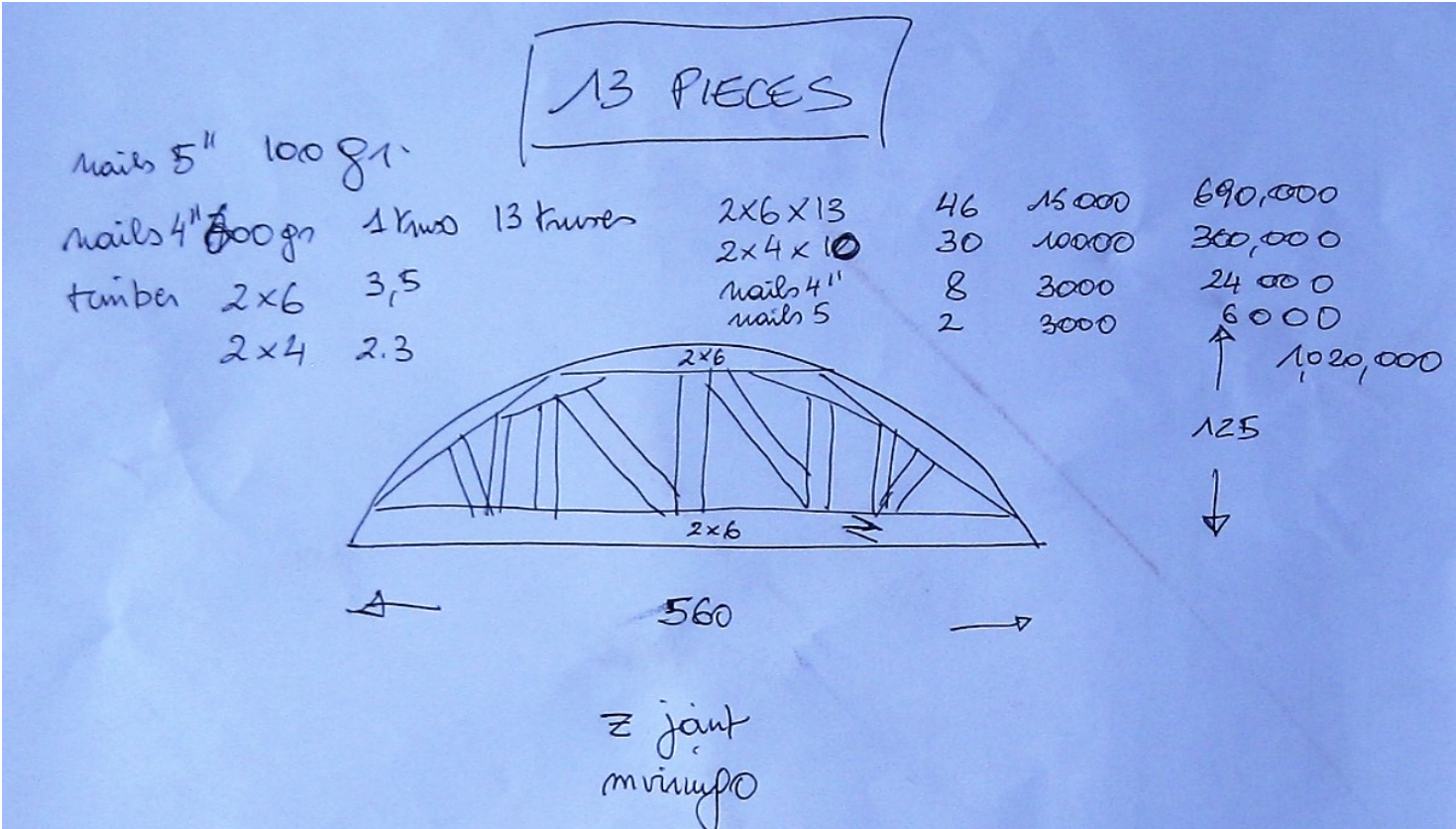
Headwalls

Deck





Setting out
 Foundations
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 Abutments
 Wingwalls
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Aligning small arches - moulds





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Picture of bad top finishing
headwall





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Picture of bad top finishing
headwall

Picture of badly aligned gutters

Picture of gutter not sloped
outwards

Picture of gutter above road level



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- Deck surface
 - Murram
 - Stone lining
 - Good for additional strength
 - Durability
 - Easier to work with small gutter system
 - Needs less maintenance than murram
 - DESIGN?
- Picture of Chekenya
- Picture of Kanyonza for bad example
 - Important that water flows away towards the gutters
- Picture murram – badly compacted







Supervision – completion

Bridge ID	2022/30
Bridge name	MUHUNGA BRIDGE
Issuing date	14 th March 2023

FOUNDATIONS	assessment	remarks
Foundations haven't settled at a different rate to each other	5	
Alignment has not altered	5	
There is no scour at riverbed around foundations	5	Rest on Red rock
Pointing	1	Not finished

ARCHES	assessment	remarks
Shape of the arch	5	
Pointing	5	
No cracks on the arch ring (visible in elevations)	5	
No cracks on the arch barrel (underside)	5	
No other cracks	5	
No holes between stones without mortar or small stones	4	
All bags burnt / removed under arch	4	
No seepage of water through the arch barrel (underside)	4	

ABUTMENTS / SHOULDERS	assessment	remarks
No holes between stones without mortar or small stones	5	
No cracks	5	

WINGWALLS	assessment	remarks
No cracks at connection with abutment or headwall	5	
No cracks in the wingwalls	5	
Wingwall is straight, square and flat	5	
Weeping holes through open joints	3	
Pointing	3	
No erosion behind wingwalls	5	
Water is drained away from the wingwalls on road approach	9	The connection to the abutment and grant

HEADWALLS	assessment	remarks
No cracks in headwall	5	
No cracks in small arches in headwall	3	
Headwall is straight, square and flat	5	4 heavy cracked ones
Pointing	3	
Gutters or pipes drain water away from outer surface	5	not completely finished around gutters

PIER TRIANGLE SHAPES	assessment	remarks
No cracks	5	
No cracks at connection foundation, abutment, headwall	5	
Triangle shape is straight, square and flat	3	One side isn't straight
Pointing	4	

ROAD SURFACE	assessment	remarks
No puddles remain on carriage way after rain	3-4	some standing water
All water drains through gutters or pipes	5	
Surface is smooth	4	
Murram is well compacted on approaches	5	not enough murram
Murram is well compacted on bridge	1	
Stone lining shows no cracks	5	
Stone lining has completely filled joints	5	
Stone lining has no loose stones	1	not accessible yet

GUTTERS	assessment	Remarks
i/Alignment of gutters	4	the alignment isn't to great same protrude than others
ii/Positioning of gutters	4	
iii/Drainage of gutters		
iv/Finishing (filling of joints)	2	Need more fine finish

Remaining point
finish painting

- around gutters (first fill holes)
- around foundation piers
- around connection wingwall to vertical part arch
- front 1 wingwall after excavations

complete backfilling by TAKURA

Overall remark

gutters need to have the same overhang everywhere - 20cm



Maintenance

- **Small maintenance**
by village -
Cleaning of debris
- **Periodic large maintenance** -
TARURA is setting
up strategic
maintenance
approach

