Pendentive domes – diameter = diagonal
lower profile, easiest to do –

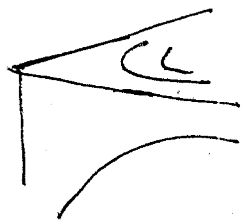
bricks 25×15×5

Placing the bricks at an angle straight to the line from the centre (10-15°) reduces likelihood of slipping during construction but intact complete rings are stable – with two masons this is easy. The 10° inclination can be introduced as a refinement. It was not being used by Nubian master masons we trained with

Compression rings.
(Trace dome) – string or pole from centre. String easy
Pendentive on 3.50 - 4 metre dome – 2½ hrs each
Dome in stages – 7 hours, then 5 hours, then 3 hours –
ie as weight increases, allowing drying but intact
structure, as with vault is stable before drying

7cm deep
use 75% clay 25 shells 10% c.

Time scale. Footings 5 days. 1 mason 2 lab. — 30 cm deep 70 wide
Walls to spring points. 6 days. 1 m 2 L
Arches and mirror walls 6 days 1m 2L
Vault + blind arches 6 days 1m ~~2~~ 1L
pendentifs and ring beam – 4 days. 1m 1L
~~Con~~ dome 5 days 1m 1L
wall finish.



Bricks stabilised 7% cement for vault. dome. ~~arches~~

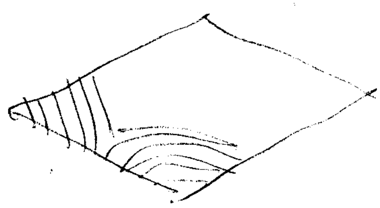
Cinva ram blocks 29-10-14 ~~for~~ 10% for footings

Stabilised blocks 7% made by hand for walls 40·10·20.

2 room house. ~~500~~

Make wooden brick moulds.

– 60 cm ~~walls~~. Foundations



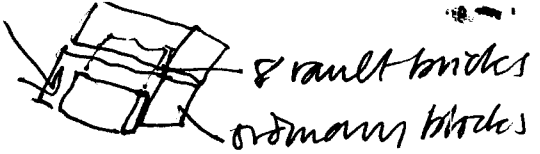
40 cm walls

DO BONDING DRAWINGS

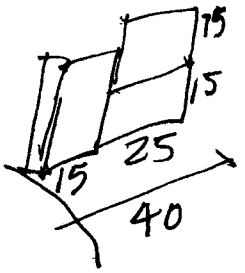
2 metre arches –
0.80 arches –

The formwork has 'rayons' drawn on it to indicate inclination of each brick
easy idea.

Smaller outer skin to take perpendicular.

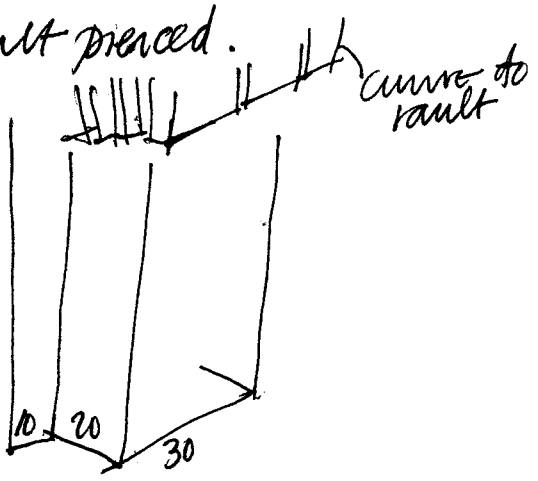


For window - 80cm. r. 40.



vault bricks

Where vault pierced.



Shuttering - can have mobile rayon - ie pole fixed by nail rotate + give alignement of each brick.

Corbelled openings

Rossi. 250 span 1.50 rise

CALES - french word for a 'GAZ'

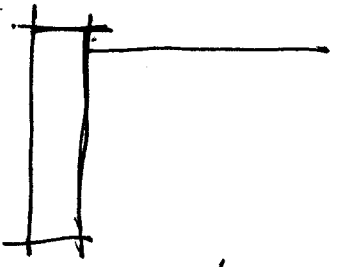
Angle of inclination 15°

inner face of bricks touching

Straighten up towards end.

We vault purlin so that support arch for dome can be built over it. As in our egypt house.

transfer from catenary to semicircle



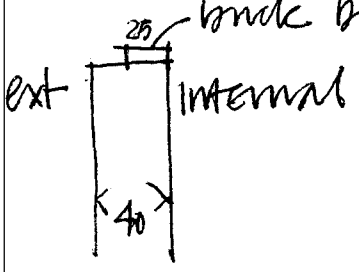
The question of shifting dome bricks out of their true inclination seems an unnecessary refinement when using mud brick. But perhaps reasonable with soil cement where cutting harder. depends on mortar. a not soil cement mortar might be sticky enough

CHALK · gypsum.

Builders learning include learning to read plans, layout
Basic principles of good building.
Use of models.
APPARELLAGES = BONDING
Back to work of skipping - MORTAR
vault - loosing right inclination and profile ie
in both direction -

getting longer - a perspective tendancy

brick beginning pendenting.



10% CINVA RAM BLOCKS - FOUNDATIONS - DEPENDS ON LOCAL SOIL.

& CLAYEY - (use some lime) no - makes difficulties because slow drying -

CEMENT Prefers sandy soil -

Teams of two
in Gourna - after 2 months apprenticeship
can build 3 m span vaults a rate of 0.2m / hour
= 2 metres / ten hours

Concrete soil cement mortar for building

REPÚBLICA POPULAR DE ANGOLA

ASSUNTO:—

Interlocking block

Roof Brick 15 × 20 × 6

Wall block 19 × 40 × 10

Dwram block

Soil cement mixture 1:10

Clinical block 19-40-10 (13 kg)

└ roof 15×20×6

water 3:1 ratio.

→ 3 part sandy soil

→ 2 part clayey soil

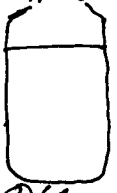
1. Test local soil, render test.

IF SOIL CLAYEY

MODERATELY =

SPREAD ON WALL 5mm IF CRACKS, ADD SAND

SAND CEMENT



CRATERRE

IF SOIL FAIRLY SANDY — CEMENT OK — 10%

SOIL CEMENT COAT 5-7%

OUTER COAT RICHER 10% OR MORE 15%

GET AS MUCH CEMENT AS POSSIBLE

(IDEALL SAND CEMENT FINISH)

BITUMEN 5% DILUTED WITH OIL

40%

GET BITUMEN RUNNY ↑ 60% DIESEL OIL SUMP OIL

MIX DIRECTLY WITH MUD.

WAX — 5% OF BITUMEN MIX.

(CANDLE 1:20

we used soap as an emulsifier but not strictly needed.

COEFFICIENT OF MOISTURE & THERMAL EXPANSION DIFFERS BETWEEN CLAY AND CEMENT. BUILD UP IN LAYERS GIVES BETTER ADHESION - WEAK TO STRONG

SOIL CEMENT BLOCKS → CEMENT RENDER.

- MORTAR - SOIL CEMENT BLOCKS, USE GYPSUM WITH EARTH (CLAY)

PROPORTIONS

NAZDIS POURED A GYPSUM SLURRY OVER THE WHOLE THING,

CEMENT SLURRY

Vault + dome construction requires team work —— two people to begin with from BW

MUD BRICKS SHOULD BE LAID DAMP ON BOTH SURFACES FOR ADHESION

DAMPEN BRICKS

2 DAYS large dome

REPÚBLICA POPULAR DE ANGOLA

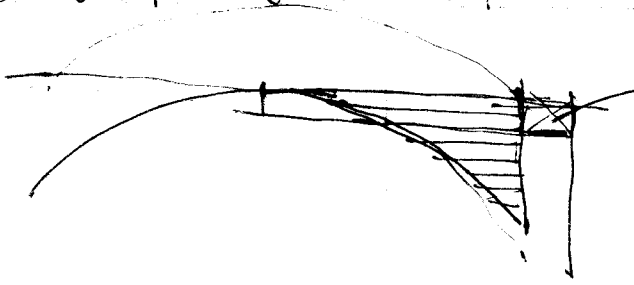
Cuvra ram: 29.3 x 14 x 8.9 tersteram. 29.5 x 14 x 8.8. 400 ± dm³	Belgian.

ASSUNTO:—

(1) ~~[illegible]~~ WILL SEGMENT STANDUP? ABOVE RING BEAM.
-ANALYSIS SUGGESTS YES depending on presence of tensile strength. absence of TS is not logical.

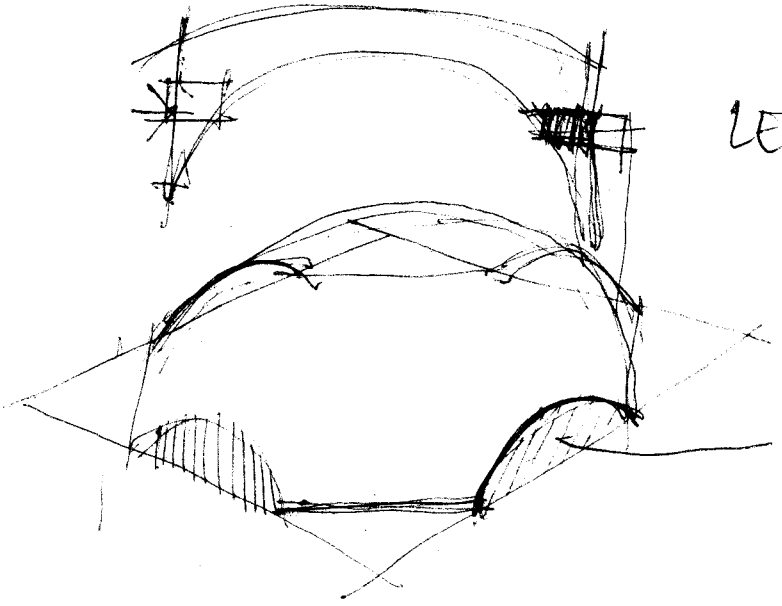
(2) HOW TO DESIGN THE RING BEAM.

(3) POSSIBILITY - BUILD UP THE PENDENTIVES UP TO COULD BE CIRCULAR RING BEAM



NOT VERY NICE + USES LOTS OF MATERIAL

RING BEAM COULD CURVE HALF WAY -!



LESS MATERIAL

PART SEGMENT

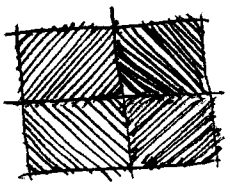
VAULT BRICKS - 10 x 20 x 4 — NICHER 12 x 20 x 4 (5)
DOME SAME

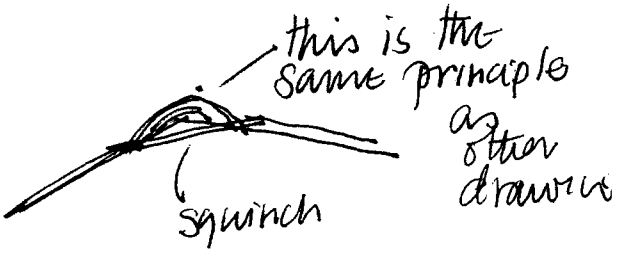
REPÚBLICA POPULAR DE ANGOLA

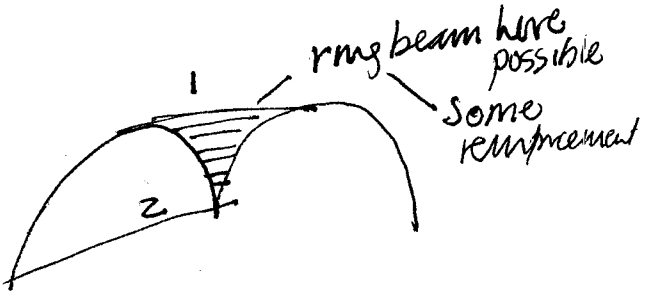
ASSUNTO:—

MAHSHALLAH ON VAULTS

Main vault type 25 cm rise in 1m
Vault must be covered with a second layer of bricks –
'gaz' to be used – stone chips between bricks
fill gaps with chalk



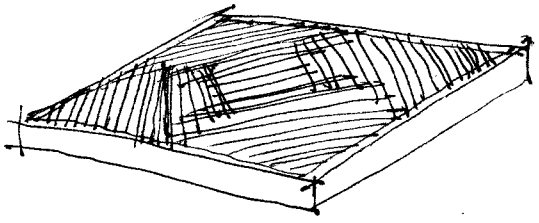




In Iran we used 20×20×6

very shallow jack arch

also shallow domes on jack arch principle
but using 4 segment approach as in Yazd
good for 2 storey



Vaults by DW in Egypt: span 150 rise 165 (VAULT 1)

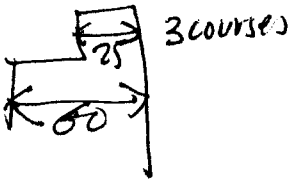
wall 3m high 50cm wide, 53 at bottom including slight batter.

VAULT 2

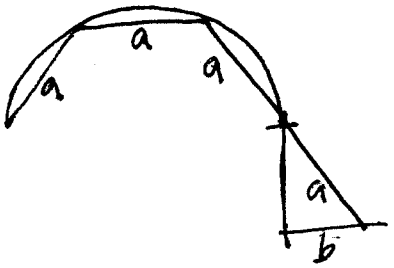
0·5 ÷ 0·6 ration span to height.

0·3 possible. (Of course + lower)

Sat dome on 60- with 0·25 at top inter edge



Trapezium rule for calculating wall thickness –



Mortars gypsum + lime

gypsum and earth –

clay for mud brick – or same material, wet surface.

Mud domes different from brick + stone domes - mortar does not form shell structure. Many points for stress concentration.

→ HOMOGENOUS SHELL

- Domes are much more stable than vaults. Double curved form.
- wastes material than vault. ∴ lighter
- thrust evenly distributed over four walls as opposed to two.
- can be used to cover larger spans

vault more versatile in spaces it can cover, but this is not strictly true. using segmented dome construction

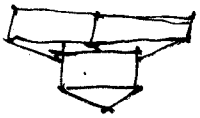
Thickness t/L = 0·05 thickness to span ratio can be thinner dome because of favourable load distribution

Self sustaining compression rings.

Semisphere easy to construct.

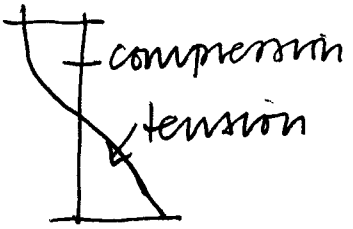
NUBIAN system lays successive courses with steeper inclinations.

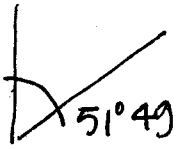
corbelled corners - horizontal coursing to move out to circle



Squinch arch

pendentive - diameter equivalent to diagonal
dome shallow



Forces in a uniform shell - 

Hoop stresses running horizontally around the curve of the dome are compressive in the upper portion and tensile in the lower. Change occurs at 51°49' from crown (38° 11' from horizontal)

Unlike the catenary where the compressive forces are continued to the horizontal.

arching stresses which follow the curve of the from ~~arch~~ downward are compressive.

If these hoop stresses can be contained, ~~forces~~ or countered then reactions of the hemi spherical dome on its supports are purely vertical and forces can be easily ~~can be~~ transmitted downwards - INTRODUCE tension rings - ie can be in buttressing or thickening the dome round its base.

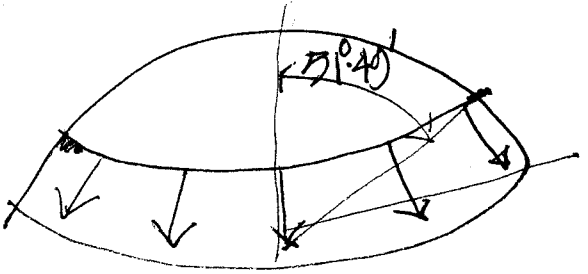
Lighter structures can be built corresponding to the upper segment which remains in compression - But here there is thrust which must be ~~carried~~ countered by buttress, counter thrust, thick walls etc.

Shallow dome characteristic of Islamic and byzantine architecture where tensile material scarce.

High stresses occur wherever there is a sharp change in curvature. Compensate by thickening or reinforcing

Another system. Small arches from corners - 

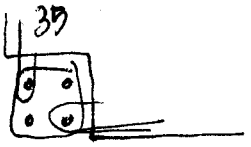
Spring 1.60



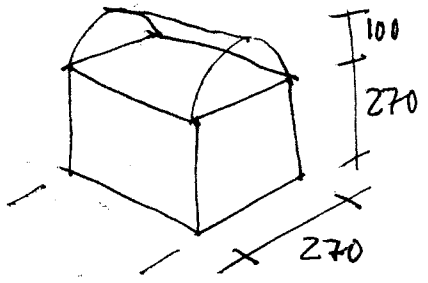
MODELS : IRAN.

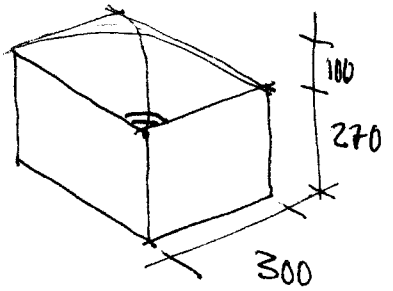
1) Iranian vaults do not lean BUILT straight and pick up slope as they go along-

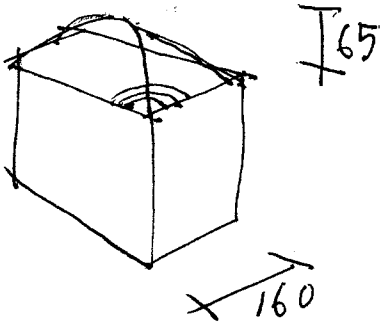
2) Reinforcing in corners

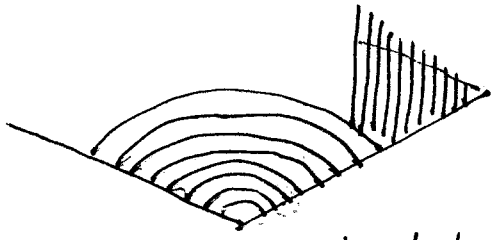


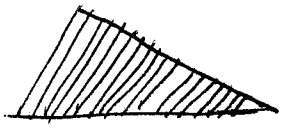
Walls 35. fired brick



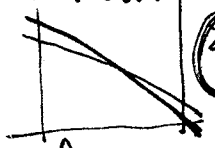






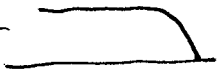


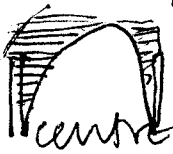
The courses are laid leaning back so that the are almost at right angles to the rise. curving very slightly nearly



40 ~~45~~° rise.

rear wall for mirror curved to match vault shape.

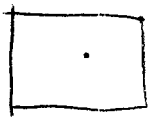
alternative is make back vault  where no rear wall used but coming up of end wall base  which has elements of the segmental dome technique

Can cut off segments in pendentive dome (Byzantine) at different levels.  but need to calculate position of cut  relative to centre point. Fanny Barrons

Capping brick quite nice 

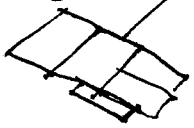
dome bricks according to Jos Lexeaux laid lengthways

— important material saving



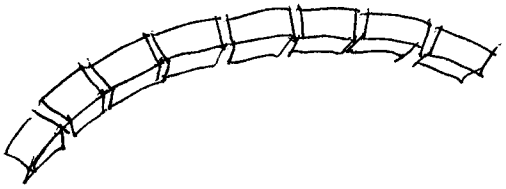
using different arcs to draw blind arches

filling in wall behind squinches. Wall single brick thick



I assume 40 cm block

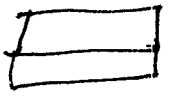
anyhow corners stronger—



using angular brick ie

10 x 20 x 40

would do

laid 

but harder as you

get higher—

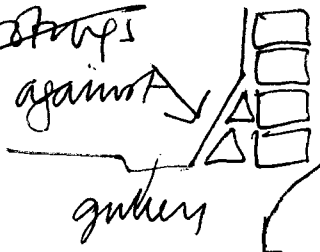
a smaller bricks as in our

Iranian 20 x 20 x 6

Square. more suitable

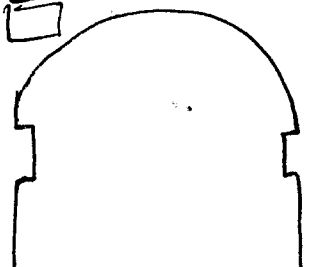
Construction ~~footings~~

protection against rain



gutter

support for shuttering



could be built in

Nanang blocks 38.5 x 18.5 joint 1.5 cm

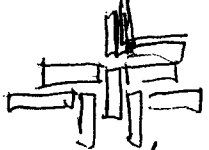
∴ wall thickness 38.5

Then used cement blocks

non load bearing walls at 18.5

most corner reinforcement common—in most seismic projects now being built

problem of availability to self builders - ie Bazaar picture.

Brick patterns 

Wall experiment used raw blocks 20cm thick