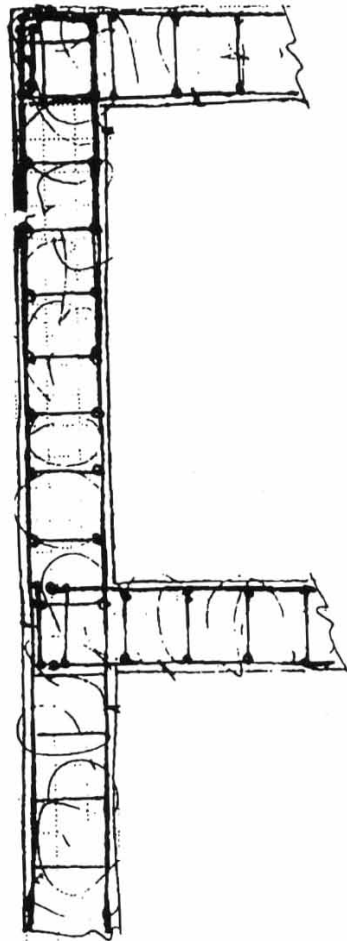




## APPLICATION OF GALVANIZED WIRE-MESH FOR STONE WALL CONSTRUCTION



BACIP INCOMING MAIL

DATE 08-06-21

REQ NO. 202

ACTION

OR



NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LTD  
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# NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

Building No. 17, Markaz F-6, Super Market, Islamabad Pakistan.



No.

June 5, 2000

Mr. Sjoerd Nienhuys  
BACIP Programme Director  
River View Road, Near Chinar Bagh Bridges  
Gilgit, Northern Areas  
Pakistan

## APPLICATION OF GALVANISED WIRE-MESH REINFORCEMENT FOR STONE CONSTRUCTION

Dear Sir,

This refers to your e-mail dated March 12, 2000 to our Principal Engineer (Structure) Mr. Mushtaq regarding the subject matter. On your visit to our office, a detailed discussion was also held to comprehend fully the intent of the work. Consequently we have made an attempt to prepare the first set of calculation for common "two stone" wall construction, on the basis of the following:

- \* Ground Floor plus one for different size rooms block with
  - Ground floor 18" thick two stone wall construction
  - First floor 12" thick stone wall.
- \* Stone wall construction will have only the faces masoned so that the wall mass will be 85% of that of stone.
- \* As per the seismic map given in the Building Code of Pakistan, Gilgit lies in seismic zone 2 (moderate seismic zone). The various applicable factors are:

Zone factor	Z	=	0.375
Importance factor	I	=	1
Structural system (Shear wall) ...	K	=	0.8

- \* For design and analysis purpose, the suggested stone wall reinforced with strips of G.I galvanized wires, shall be considered a type of reinforced concrete. Certain fundamental assumptions as applicable to the reinforced concrete & hence to reinforced stone construction, shall be as under:

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1. When the reinforcement is strongly bonded to the concrete, a stone like material, a strong, stiff and ductile construction material is produced. In case of suggested stone masonry, the adherence between the galvanized wire and stone construction, is achieved, by making provision of a long ladder type strip, knotted from the galvanized wire in such a way that the knots provides optimum grip power with the surrounding stone construction. The weight of the next layer of stones keep the (link wires of galvanized wire) ladder/strip tightly in place and provide a full binding between the two faces of the masonry.
2. Sections which are plane before bending remains plane after bending.
3. Concrete & hence stone is effective only for the purpose of offering compressive stresses. No tension is taken by the stone and the same is resisted entirely by the GI galvanized wires.
4. Both stone (or concrete) and GI galvanized wires shall be considered elastic materials. If two different elastic materials are connected together so that the one can not stretch or shorten independently of the other, the intensities of stress in the materials are in the same ratio as that of their elastic modulus i.e. the stress in the one material will be  $m$  times the stress in the other,  $m$  being the modular ratio of the two materials.
5. Since reinforced concrete is not a proper elastic material, its stresses can not be accurately predicted by the traditional equations derived for elastic materials. Much of reinforced concrete design is therefore empirical i.e. design equations and design methods are based on experimental and time proven results instead of being derived exclusively from theoretical formulations. The same is also valid for reinforced stone construction, but in absence of any experimental or time proven results data, this study is restricted for the theoretical aspects only ignoring such code requirements for reinforced concrete like minimum reinforcement for flexure members, spacing limit for reinforcement, limits for reinforcement of compression member, development & splices of reinforcement, minimum wall reinforcement, minimum reinforcement for shrinkage and temperature etc.

6. Design parameters for stone construction reinforced with GI galvanized wire shall be as under:

- a) Stone, density =  $0.85 \times 120 \approx 100$  pcf.  
f<sub>c</sub> = 500 psi (for stone)  
E Stone =  $57000/\sqrt{f_c} = \text{or } 1.275 \times 10^6 = 183536$  KSf
- b) GI galvanized wire f<sub>y</sub> = 60000 psi  
E Steel =  $29 \times 10^6$  psi
- c) Elastic modulus ratio =  $29/1.275 \approx 20$
- d) Poissen ratio = 0.15

On the basis of analysis & design, (Analysis conducted using Staad-Pro package) for the stipulations given above the various conclusion drawn pertaining to stone wall construction are as under:-

#### A. SINGLE STOREY HOUSES

- 12" thick stone wall with only faces masoned with (1:6) cement sand mortar.
- All external & internal walls will be reinforced at every course 11" wide with strips of two G.I galvanized wires of 2.3 mm dia links being wires of 2 mm dia fixed at intervals of 1'-0" intervals.
- Maximum free length of wall shall be 14'-0".
- All ends /junctions shall have 11" wide vertical strips of two wires of 2.3 mm dia with links of 2 mm dia, wires fixed at intervals of 1'-0" intervals ( to be anchored with course reinforcement bent upward at ends).

#### B. TWO STORIED HOUSES

##### i Ground Floor

- 18" thick stone wall with only faces masoned with (1:6) cement sand mortar.

- All external & internal walls will be reinforced at every course 17" wide with strips of two G.I galvanized wires of 2.3 mm dia links being wires of 2 mm dia fixed at intervals of 1'-0" intervals.
- Maximum free length of wall shall be 21'-0".
- All ends /junctions shall have 17" wide vertical strips of two wires of 2.3 mm dia with links of 2 mm dia, wires fixed at intervals of 1'-0" intervals ( to be anchored with course reinforcement bent upward at ends).

**ii First Floor**

Same as given for single storey houses.

The criteria set out above have been formulated in good faith to the best of our abilities and knowledge in the field of structural engineering. Our responsibility is limited to the reasonable care in making theoretical studies and investigations. Recommendations give above are based on hypothetical studies and need confirmation by some experimental data and test result.

We hope this meet your requirements as first set of calculation for stone construction.

Our man-hour input cost for this assignment alongwith NESPAK man-hour cost are enclosed herewith for the payment at the earliest possible.

Thanking & assuring you of our best professional services at all time

For National Engineering Services Pakistan (Pvt.) Limited

  
(RANA KHALID HAMEED)  
Chief Engineer

Encl. As above.