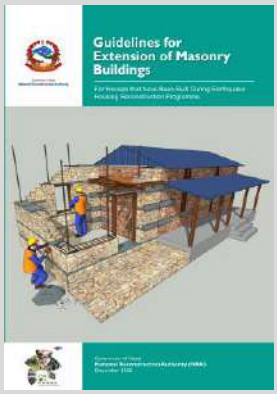
Government of Nepal
National Reconstruction Authority

Guidelines for Extension of Masonry Buildings

For Houses that have Been Built During Earthquake Housing Reconstruction Programme

Government of Nepal
National Reconstruction Authority (NRA)
June 2021



GUIDELINES FOR EXTENSION OF MASONRY BUILDINGS
for houses that have been built during Earthquake Housing Reconstruction Programme

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Foreword

We have been receiving reassurances that the NRA's owner driven approach has created built in dynamo for accelerating housing reconstruction while maintaining construction quality. The NRA deployed more than 3000 engineers and social mobilisers at the grass root level for the first time in Nepal's history which has left its footprints not only in the form of reconstructed houses but also for embedding earthquake resilient technology at the lo cal level. NRA ensured compliance through three tranches system of housing grant by ensuring adherence of building code in each crucial stage.

At present, 92% of about 850,000 beneficiary houses have been reconstructed across the 32 districts. There are certain issues of vulnerable households and urban housing reconstruction which we are grappling through appropriate policy intervention.

With this publication, we intend to ensure future extension also complying with the building codes. We are fully confident that the local governments, who are formally trusted to handle the promotion and sustenance of the housing stocks in the county, will leave no stone unturned towards that objective. They will find this publication instrumental for carrying forward their responsibility.

We are confident that the Government of Nepal (GoN) will propagate the earthquake resilient technology to all 77 districts of Nepal. There are certain conceptual, technological and procedural elements which can be replicated in other countries as well particularly where our socio-economic situations are identical.

This is one of the publications of the International Conference on Nepal's Reconstruction (ICNR-2021). We have been recording NRA's experience holistically and present to the national and international audience. Hope all communities vulnerable to earthquake will benefit out of these ICNR publications.

Sushil Gyewali

Chief Executive Officer
National Reconstruction Authority

Acknowledgements

We would like to express our gratitude to the team of professionals for their contribution, guidance and quality assurance. Mr. Shyam Kishor Singh, Mr. Jhapper Singh Vishokarma, Mr. Surya Narayan Shrestha, Dr Ramesh Guragain, Mr. Bipin Gautam, Ms. Hima Shrestha, and Ms. Rajani Prajapati contributed on the conceptual discourse and on the critical issues.

Acknowledgements are due to the commentators on the draft report: Dr Hariram Parajuli, Mr. Jitendra Bothara and Mr. Vivek Rawal. Their highly professional inputs enhanced its implementability. In addition, ICNR Secretariat including Dr Chandra Bahadur Shrestha, Convenor; Mr. Manohar Ghimire, Member Secretary and Mr. Sandeep Gurung, Junior Conference Expert facilitated the entire process.

Mr. Ranjan Dhungel, Mr. Aasish Tiwari, Mr. Ayush Baskota, Ms. Parbati Motra, Mr. Manish Raj Gouli, Ms. Geeta Bhandari and Mr. Chandan Dhoj Rana Magar deserve our heartfelt appreciation for their contribution to draft this document. Only through their tireless efforts, this document saw the day light.

In addition, we extend our sincere appreciation to USAID for their support to Baliyo Ghar Program implemented by NSET through which this guideline is published. We borrowed substantial body of knowledge on house extension using buttresses from UNDP's document entitled 'How to extend your house safely, A Guide for Extending your House at the Ground Floor' which were co-authored by Mr. Vivek Rawal and Mr. Jnananjan Panda.

NRA organised a workshop where hundreds of participants from various governmental, non-governmental, donors and academicians contributed for the enrichment of this document. We are grateful to all of them. Last but not the least we would like to extend our sincere thanks to all individuals who contributed explicitly or implicitly.

Sushil Chandra Tiwari

Secretary
National Reconstruction Authority

Preface

NRA intended to contribute towards the creation of earthquake resilient society through "Build Back Better" principle. In retrospection, we are pleased to see that we could inject the earthquake resilient technology in 32 districts of Nepal. The technological spill over effect to other districts has been taking place through the masons who were engaged in the reconstruction of private and public buildings.

NRA was created for five years stint under the sunset law with provision of one year extension. Within that time constraint, NRA formulated policies with some premises that the earthquake victims will reconstruct their house according to their requirement within the stipulated deadline. However, having limited financial resources, dearth of construction workers and other unexplained family reasons, beneficiaries constructed their core houses which enabled them to access NRA grants. However, as they garnered adequate resources, availability of construction workers resumed, and their migrant family member returned to their house the beneficiaries kicked off vertical and horizontal extension.

It is important that such extensions must have to comply with the building code which ensures earthquake resilience. Although, it is not under the NRA's remit, we wanted to blaze trail for the local governments who are the ultimate custodian of resilient housing. Not all local governments have initiated the building permit system which we hope they will very soon. It will be also reference document for the the central level NRA's successors mainly Ministry of Urban Development (MoUD) and National Disaster Risk Reduction and Management Authority (NDRRMA).

The manual has been divided basically into two sections; the horizontal extension and vertical extension which is expected to facilitate referencing. It is expected that the description of extension under various building typologies and conditions will enable technicians and other users to refer instantly.

This "Guidelines for Extension of Masonry Buildings" will be helpful guide to the partner organizations and house-owners. This guideline will orient the technicians for inspection, evaluation and correction of the extended rooms and storeys.

Chandra Bahadur Shrestha

Executive Member
National Reconstruction Authority

Acronyms

3D	3-Dimensional
BMC	Brick Masonry in Cement
CGI	Corrugated Galvanized Iron
GoN	Government of Nepal
MR	Minimum Requirement
NNBC	Nepal National Building Code
NRA	National Reconstruction Authority
NSET	National Society for Earthquake Technology Nepal
RC	Reinforced Concrete
RCC	Reinforced Cement Concrete
SMC	Stone Masonry in Cement

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1 BACKGROUND

Significant progress has been achieved in the private housing reconstruction in the aftermath of the 2015 Gorkha earthquake under the Government of Nepal (GoN) housing reconstruction programme that facilitated owner driven reconstruction through financial and technical assistance and inspections. More than 500,000 houses have now been completed, compliant to the prescribed technical requirements set forth by the National Reconstruction Authority.

The current progress is the outcome of key strategies implemented by the National Reconstruction Authority and supported by the timely development of various guidelines and manuals to aid the government officials, technical personnel, masons and house owners in the rebuilding process. The reconstructed houses have followed the Minimum Requirements (MRs) developed and enforced by the National Reconstruction Authority following provisions of the Nepal National Building Code. The MRs clearly stated that for buildings with stone/brick masonry in mud mortar, the number of stories are restricted to only one story if wooden band is used and up to one story plus an attic, if RC bands are used.

While these Minimum Requirements were in place to ensure safety, and have largely been followed by the reconstruction beneficiaries, the decrease in usable space in the houses that existed prior to the earthquake and that have been constructed during the reconstruction process is evident. The need for additional usable space is also apparent from the beneficiaries who opted the construction of hybrid structures, with lightweight upper floor using timber or metal posts and CGI sheet panels.

Figure 1. Typical stone masonry houses in Nepal before the earthquake (left) and reconstructed after the earthquake following Minimum Requirements (right). © NSET

Now, as the reconstruction and grant disbursement process completes, many beneficiaries are intending towards expanding their reconstructed building structure to add more usable space. It is, however, necessary to ensure that the additional structure also complies with the Building Code.

Therefore, in order to ensure safety of the additional structure against seismic and other loads, it has become an urgent task to develop and disseminate adequate measures with proper construction and connection details. This manual has been developed to support the engineers responsible for providing advice and assistance to the households for the implementation of expansion measures in their completed houses.

2 SCOPE

2.1 Applicability

This manual is applicable within certain prescribed limitation based on NNBC 105: 1994 seismic design code and as guided by NNBC 202, NNBC 203, Minimum Requirements (MRs), Correction and Exception Manual, Hybrid Manual and Light Timber/ Steel Frame Structure Manual.

The designs and details set forth in this manual are applicable only to masonry residential buildings that have been constructed after Gorkha Earthquake 2015 under the GoN housing reconstruction program. This manual aims to achieve the minimum acceptable structural safety as per envisioned by NNBC 105: 1994, seismic design code. The designs that are mentioned in the manual are ready-to-use designs for all annex structural components, though some of the provisions are set as advisory measures.

This guideline is mainly targeted for the houses, which have received all three tranches of support from the NRA. This gives a clear assumption that these houses do not have technical errors while constructing the main house. Here, 'main house' refers to the part of the house, which was approved by the NRA for the final tranche. Therefore, this document will primarily focus the feasible options of expanding the main house, the steps to follow to comply the added part of buildings with NNBC.

2.2 Limitations

This manual only covers the design and details for expansion of load-bearing masonry building built with stone or brick masonry units and bonded with mud or cement mortars. The manual only applies to houses that has been newly constructed and have received the completion certificate with compliance to the Minimum Requirements set by the NRA. The options provided in this document are feasible options as a whole. If a competent engineer finds feasible options other than mentioned in this document, they can practise their jurisdiction. Any statements in this guideline if contradict with NNBC shall void the contradictory statements mentioned in this document.

2.3 Possible Extensions

Several field level observation and studies have highlighted the key structural and architectural features of reconstructed houses. The most abundant structure across the earthquake affected regions are two-room stone masonry structures with an attic. In many of these cases, people have continued the use of their temporary shelters as kitchen, storage and living. Similarly, addition of light structures as annexes have also been witnessed in several cases. Thus, the expansion of houses is presented by comparing reconstructed houses with their damaged counterparts. It is assumed that if the homeowner had sufficient investment, time, resources and no obligations (related to code provisions) at the time of reconstruction, they might have built their house similar to their damaged houses. Hence, this guideline presents feasible cases of horizontal and vertical extensions to fulfil the need of additional space.

3 HORIZONTAL EXTENSION

Horizontal extensions are expected in cases when house owners have extra land to add further rooms in any side of existing house. However, the prime technical governing condition for this type of extension is length to breadth ratio (aspect ratio). There are various possibilities of extending a house in horizontal space; however, this guideline presents four typical modes of extensions. Different units like connections of the load bearing members, maintaining proper aspect ratio and keeping the integrity of buildings are to be taken into consideration while extending a house. Extending the existing building involves intensive works from foundation to roof, an engineer shall refer to NNBC to develop the components of extended building. An Engineer shall recommend the horizontal extension speculating the following points:

1. The existing building should have
   a. been reconstructed under the Housing Reconstruction Programme of the Government of Nepal, National Reconstruction Authority (NRA) and,
   b. been inspected and approved for all three tranches of government grant support and certified for completion by the NRA

      The existing building structure or components of the building has not undergone any structural damage or problems related to settlement, tilting of walls and so forth.

   (In case of structural problems in the structure, extension using this guideline is not recommended. However, a competent engineer can recommend the best alternative to extend, if possible, studying the severity of the problem.)
2. The length to breadth ratio of the building after proposed extension does not exceed three.

   (The competent technical personnel shall be able to judge which option will be best fit for the horizontal extension.)

3.1 Cases of Horizontal Extension

In accordance with the prevalent limitations of the National Building Code, the main structure of a reconstructed stone or brick masonry building can be extended in horizontal direction following one of the following options:

- Addition of one room at one of the widths
- Addition of two rooms at one of the lengths
- Addition of wing walls to form a closed verandah at front of the building
- Addition of wing walls to form a L-verandah at front and side of the building

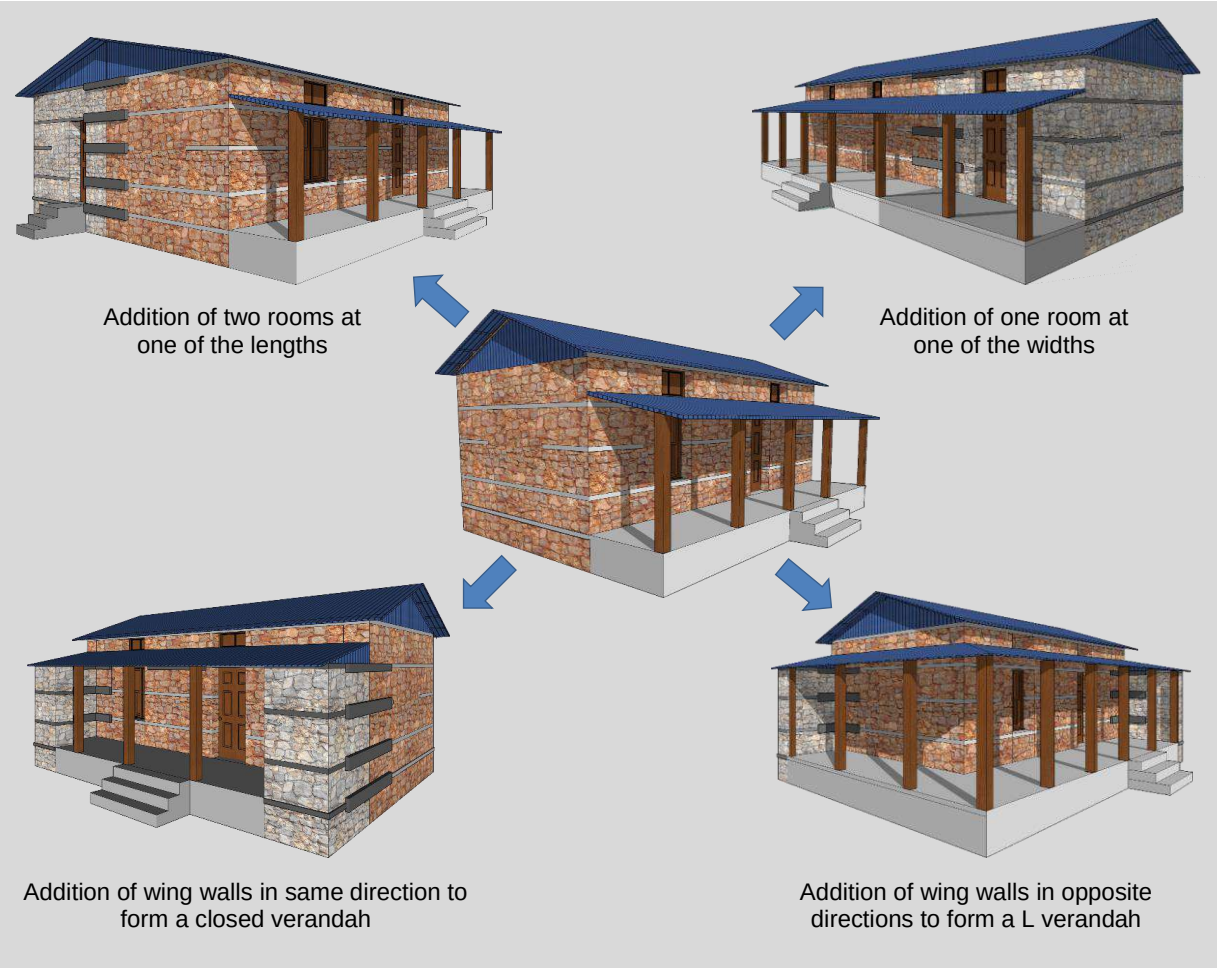


Figure 2. Feasible options for horizontal extension in stone or brick masonry buildings

3.1.1 Addition of one room at one of the widths of the building

Figure 3. Addition of one room at one of the widths of the building

In this case, a room can be added at one of the widths of the building (Figure 3). For this, C shape masonry walls must be constructed as the annex part and connected to the existing structure using "Band-Connectors" and shear keys. Horizontal and vertical reinforcements required in the construction of masonry buildings as per the NNBC must be followed in the added walls as well. While doing so, consideration must be made so as to ensure that the length to breadth ratio of the building does not exceed 3 (three). The existing floor and roof structure can also be extended along the added portion.

3.1.2 Addition of two rooms at one of the lengths of building

Another option for the extension of the masonry structure is the addition of two rooms at one of the lengths of building. For this, as in the above case, C shape walls are constructed as the annex part and are connected to the existing masonry walls using "Band-Connectors" and shear keys. Horizontal and vertical reinforcements required in the construction of masonry buildings as per the NNBC must be followed in the added walls as well. In this case however, the roof and floor structure need to be dismantled and rebuilt for the new structure.

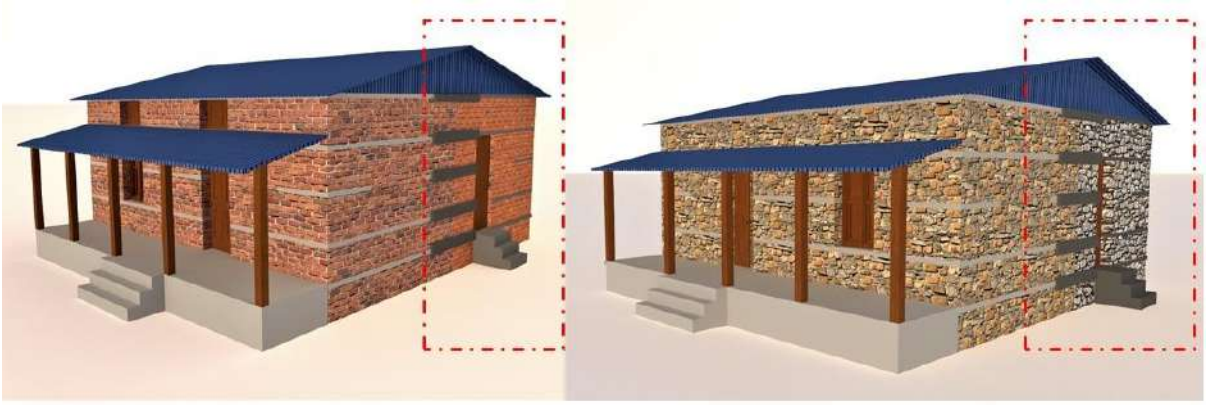


Figure 4. **Addition of two rooms at one of the lengths of the building**

An alternative method of adding two rooms at one of the lengths can achieved maintaining the continuation of the same slope of the existing roof as shown in Figure 5. However, following this process, the existing attic cannot be extended over the extended rooms. The advantage of this process over the method discussed above is that in this process the existing roof will be undisturbed, hence the cost of extension can be minimized. The roof over the added rooms can be constructed following NNBC. The detail drawings are presented in the Annex section.

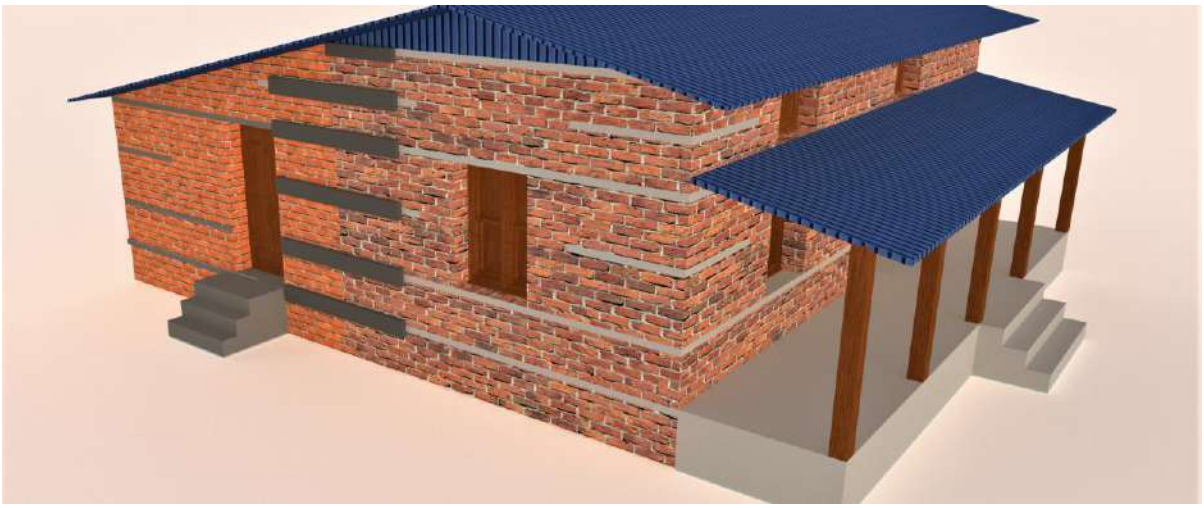


Figure 5. **An alternative method of addition of two rooms at one of the lengths of the building**

The practicality of this alternative method of addition of two rooms at one of the lengths depends on the height of added rooms at the end of down slope.

3.1.3 Addition of wing walls to form a closed verandah at front of the building

A prevalent construction technique in masonry buildings seen in the rural areas of Nepal is that of wing-walls that extend beyond the load bearing walls. These wing-walls perform as non-structural components, and provide additional usable space for verandah, storage and kitchen purposes. A similar construction technique is proposed in this guideline as well to increase the usable space of the building without any addition to the structural components.

As wing walls are unsupported walls, special consideration must be done to ensure that adequate connectivity is maintained with the existing load bearing structure. For this, Band-Connectors and shear keys are used while also providing adequate horizontal and vertical reinforcements in the new constructed walls.

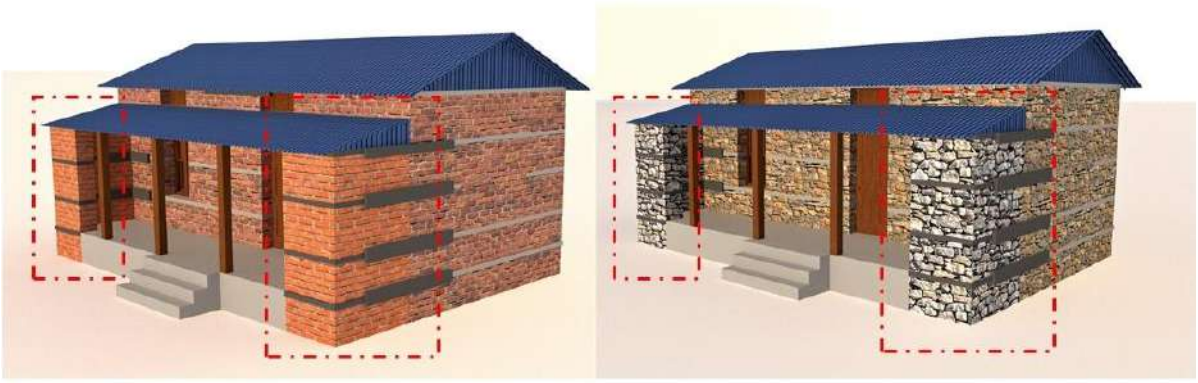


Figure 6. Addition of wing walls in same direction

3.1.4 Addition of wing walls to form a L verandah at front and side of the building

Similar to the extension above, wing walls can be constructed along two opposite sides of the building thus resulting in an L-shaped verandah across the building. Construction steps and considerations are similar to that prescribed in the above option.

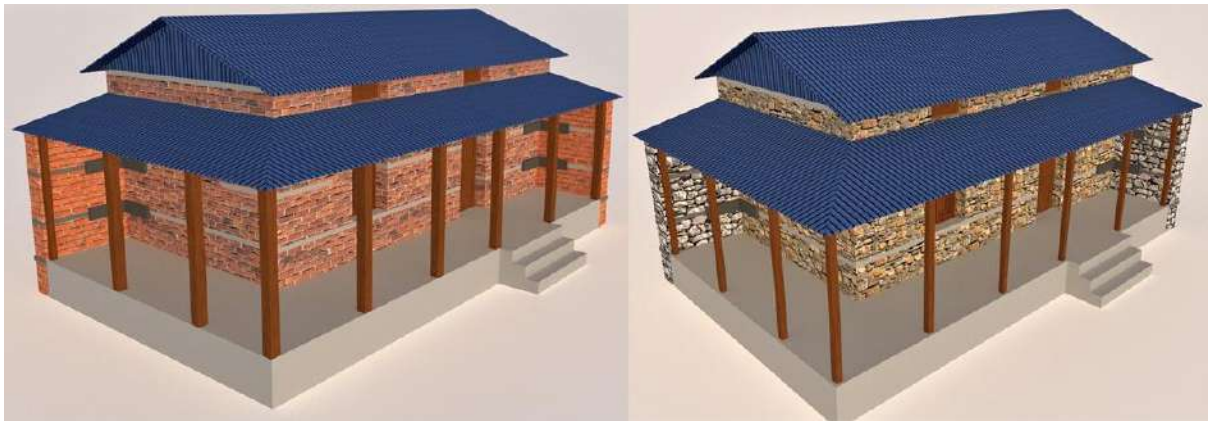


Figure 7. Addition of wing walls in opposite directions

3.2 Minimum Requirements

All the requirements related to footing, size of room, height of wall, bands, verticals and so forth to be fulfilled when extending a building shall comply the requirements mentioned in NNBC given for the construction of a new building. However, the connection between the existing wall and the new wall, the existing band and the new band, and the existing stitch and the new stitch should be followed as given in this document as these connections are not mentioned in the existing NNBCs.

3.2.1 Elements at the junction of the new and the existing walls

While rooms are added to existing buildings, it is important to maintain building's integrity and ensure proper transformation of earthquake forces. Considering this, the newly constructed walls and bands should be properly connected with the existing one. This can be achieved employing the following elements. These elements are used at the junction where the new wall meets the existing wall, whereas at other corners the detailing suggested by NNBC for new construction shall be followed.

A. Placement of the vertical reinforcement

Although there is presence of the vertical rebar in the existing wall, a vertical reinforcement shall be placed in the new wall as shown below (Figure 8 and 9). The dimension of the vertical and the embedding concrete shall be the same as suggested by the NNBC.

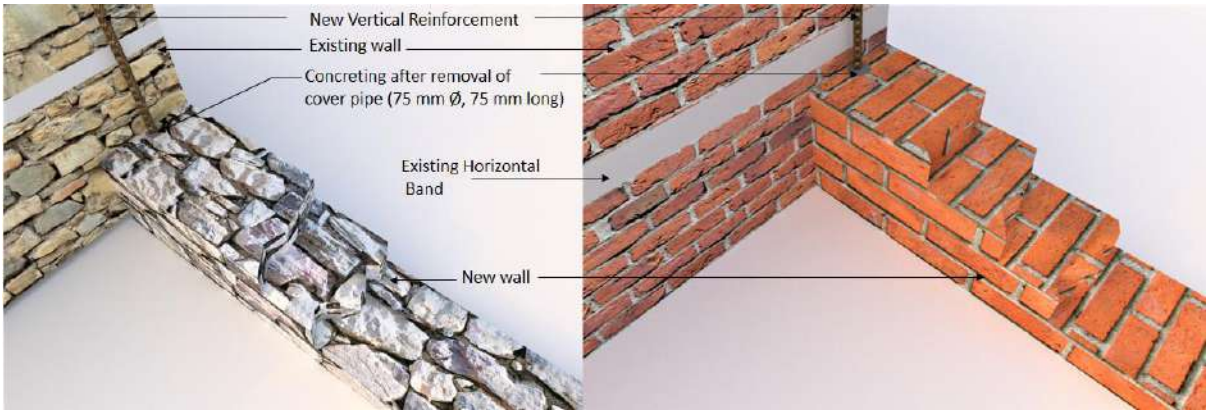


Figure 8. 3D depicting the placement of a new vertical rebar in stone masonry (left) and brick masonry (right) walls

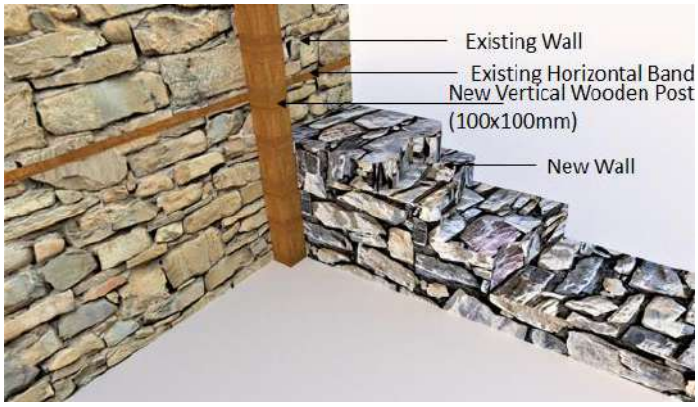


Figure 9. 3D depicting the placement of new wooden vertical

B. Integrity between the added and the existing wall

To ensure the integrity between the added and the existing wall, dowels as shown in the Figure 10 and 11 below will be provided at every 450 mm height as the new wall progresses. The reinforcement dowels will be inserted through mortar joint embedding in 1:3 cement sand mortar whereas stone keys will be placed by withdrawing the unit of stone.

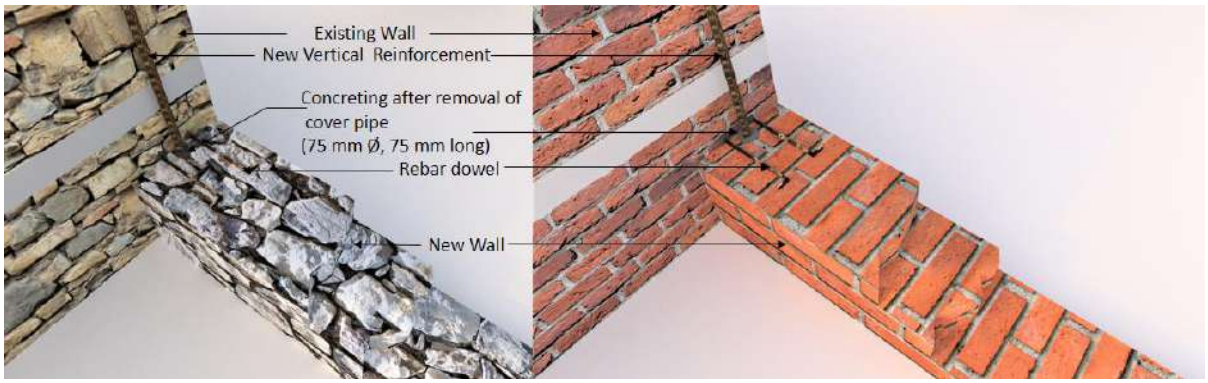


Figure 10. Dowels connecting the existing wall and the new wall in case of reinforced concrete

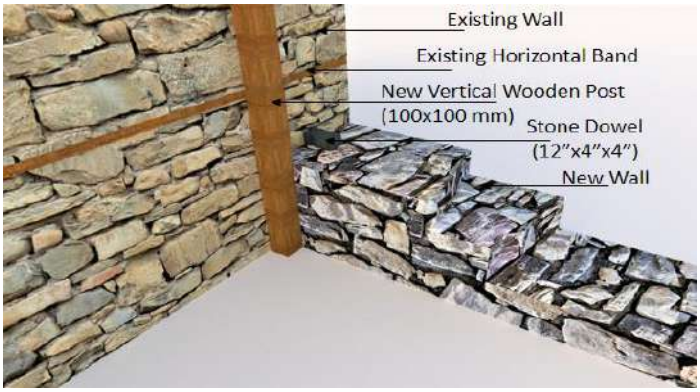


Figure 11. Stone dowels connecting the existing wall and the new wall in case of wooden reinforcement

C. Connection between the existing and the new bands/stitches:

It is not feasible to provide a continuous band in the existing wall and the new wall, as it requires the demolition and the recasting of some length of existing walls/bands/stitches of the corner at which the new wall comes in contact with the existing wall.

To solve this problem, an element to connect the existing band/stitch and the new band/stitch has been devised which is termed hereafter as a Band-Connector. The 3D drawing depicting the use of the Band-Connector is shown below (Figure 12 to 16). The details of these connectors are presented in the Annex.

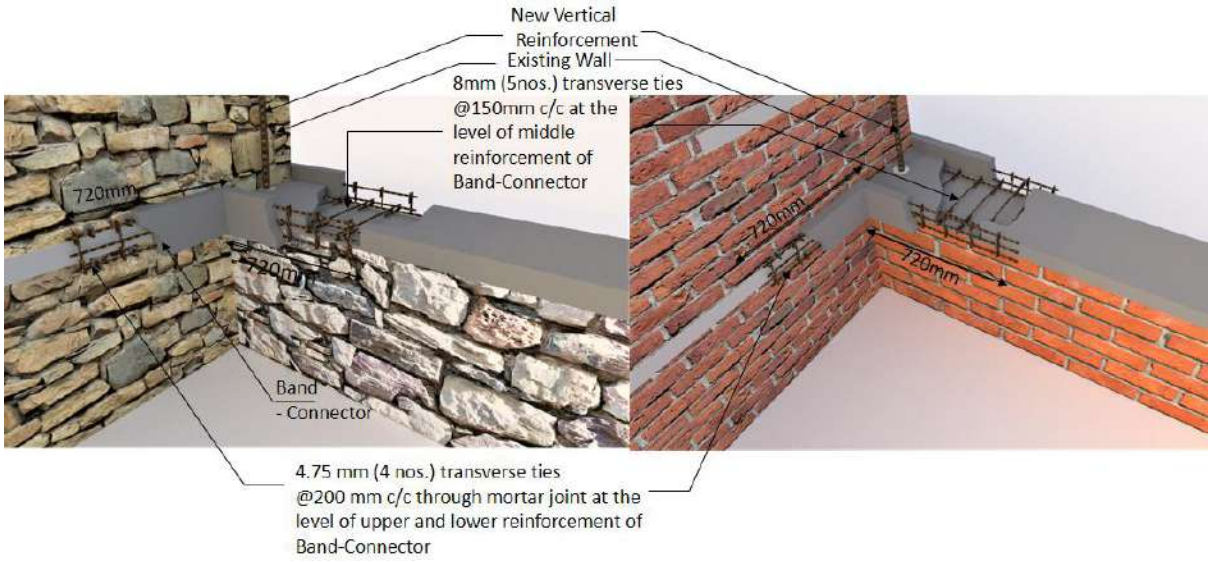


Figure 12. 3D view of RCC Band-Connector (perspective from the added room)

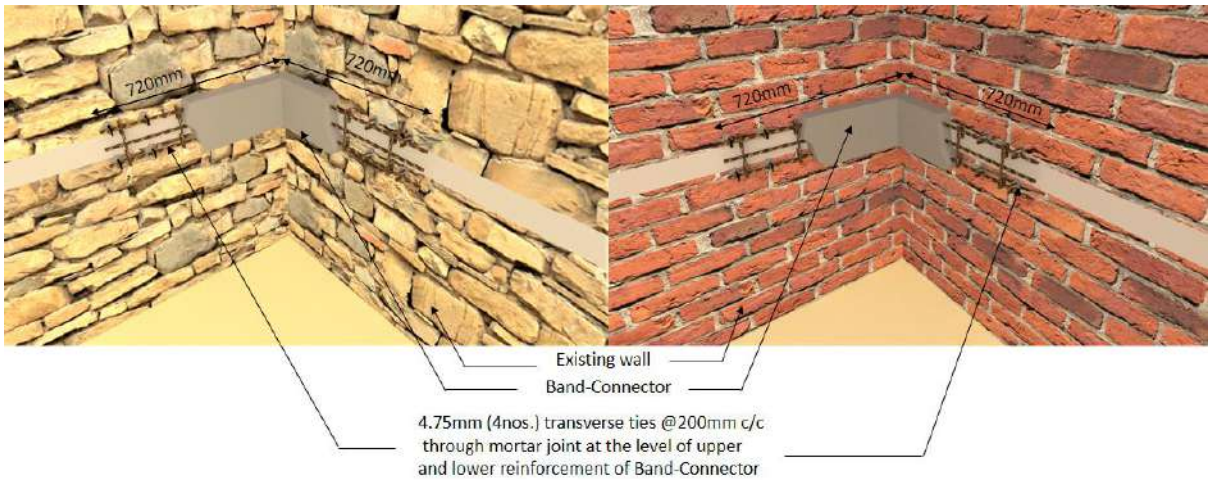


Figure 13. 3D view of RCC Band-Connector (Perspective from the existing room)

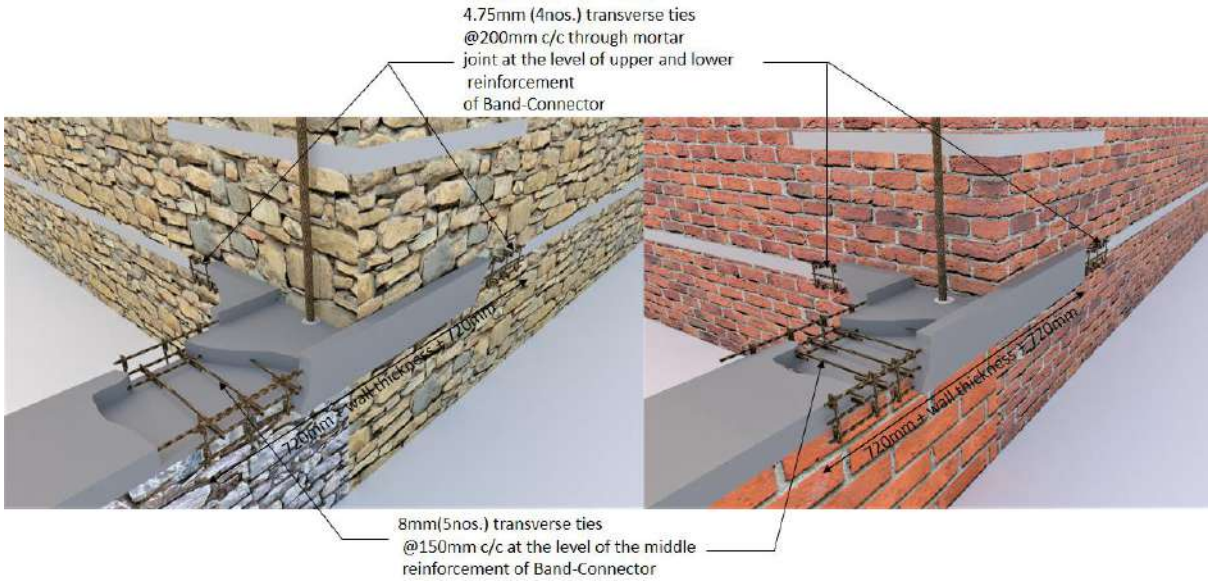


Figure 14. 3D view of RCC Band-Connector (Perspective from outside wall)

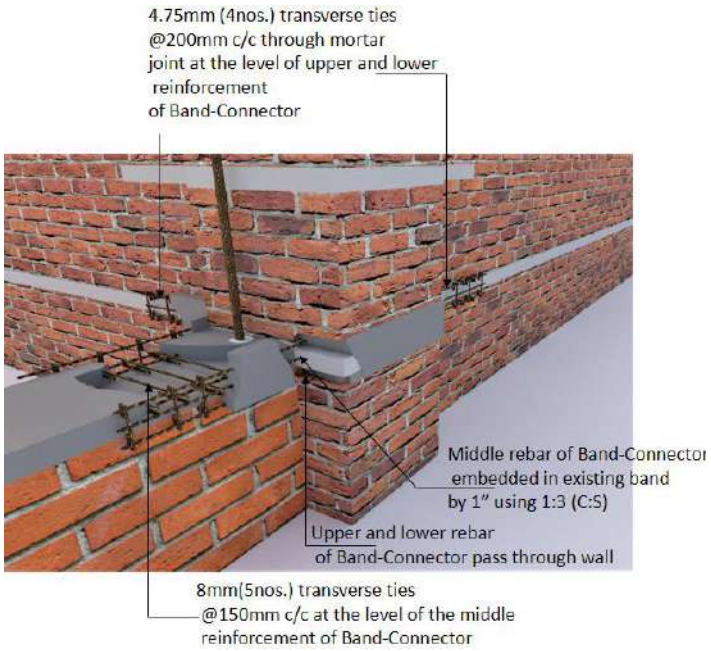


Figure 15. 3D view of Band-Connector (In case of brick masonry wall with Kopla projection)

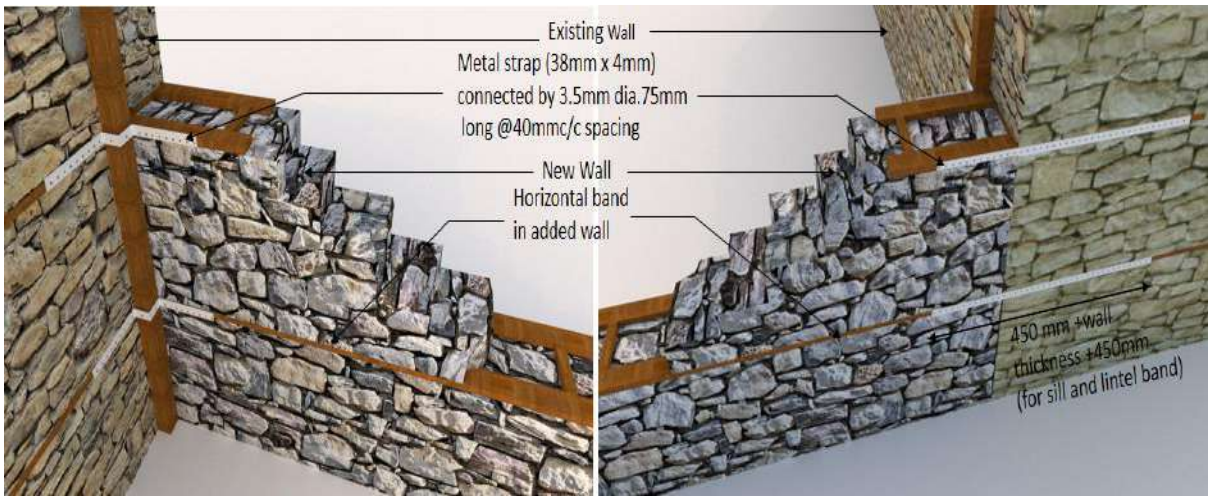


Figure 16. 3D view of Wooden Band-Connector, perspective from added room (left) and outside wall (right)

3.2.2 Connection of Roof members:

There are various roofing materials, such as stone slabs, slates, mud roofing, tiles or jhingati, thatched roof, CGI roof and so forth provided by NNBC, however it recommends the use of light roofing materials. And so far, CGI roofing is the widely used roofing material in rural Nepal. Therefore, typical connection details depicted in Figure 17 is for members used in CGI roofing. The details, such as spacing and size of rafters, size of ridge beam which depend on the span and therefore can vary from one building to next are sufficiently elucidated in NNBC. Hence, it is recommended to follow NNBC according to building characteristics.

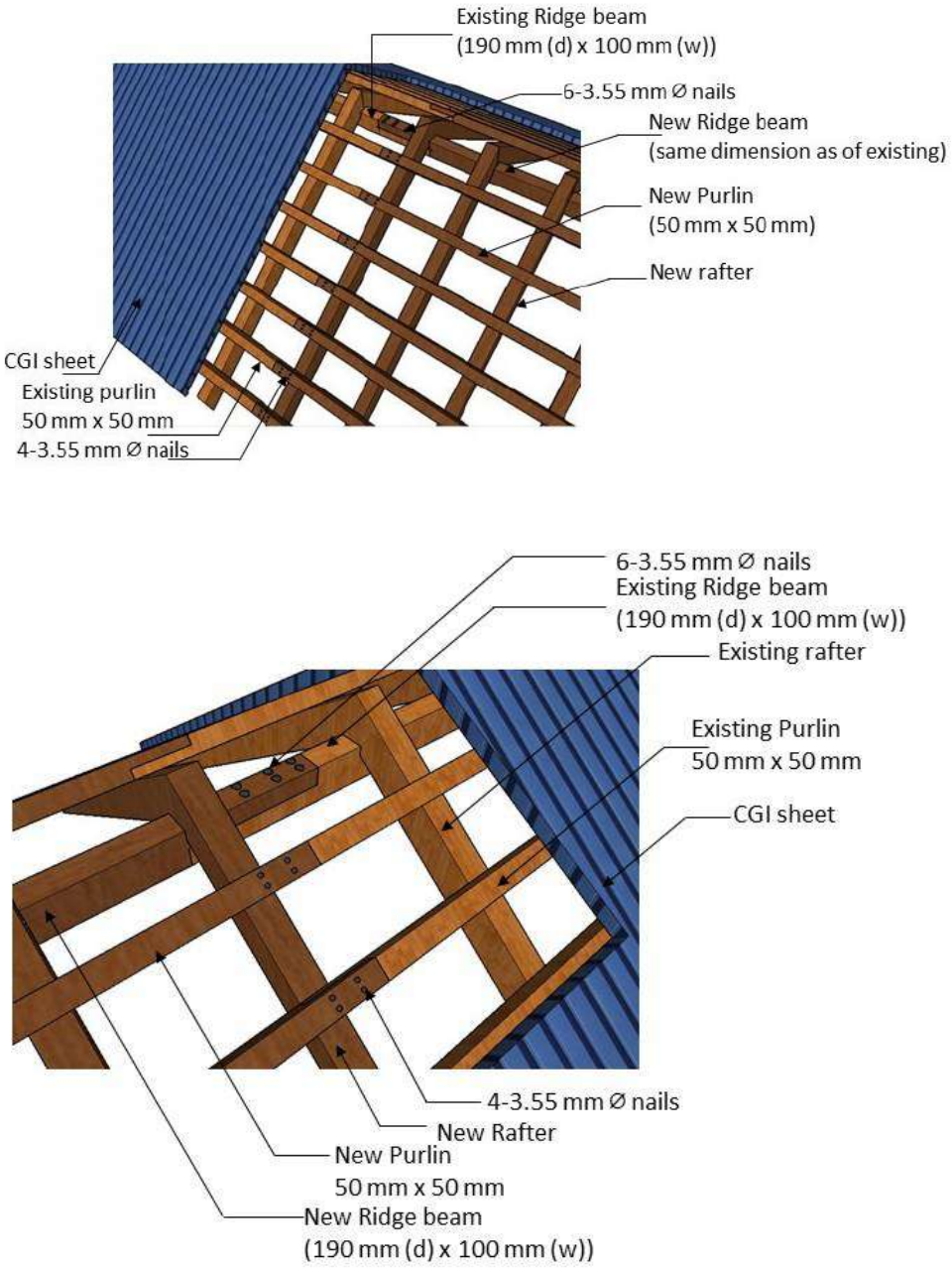


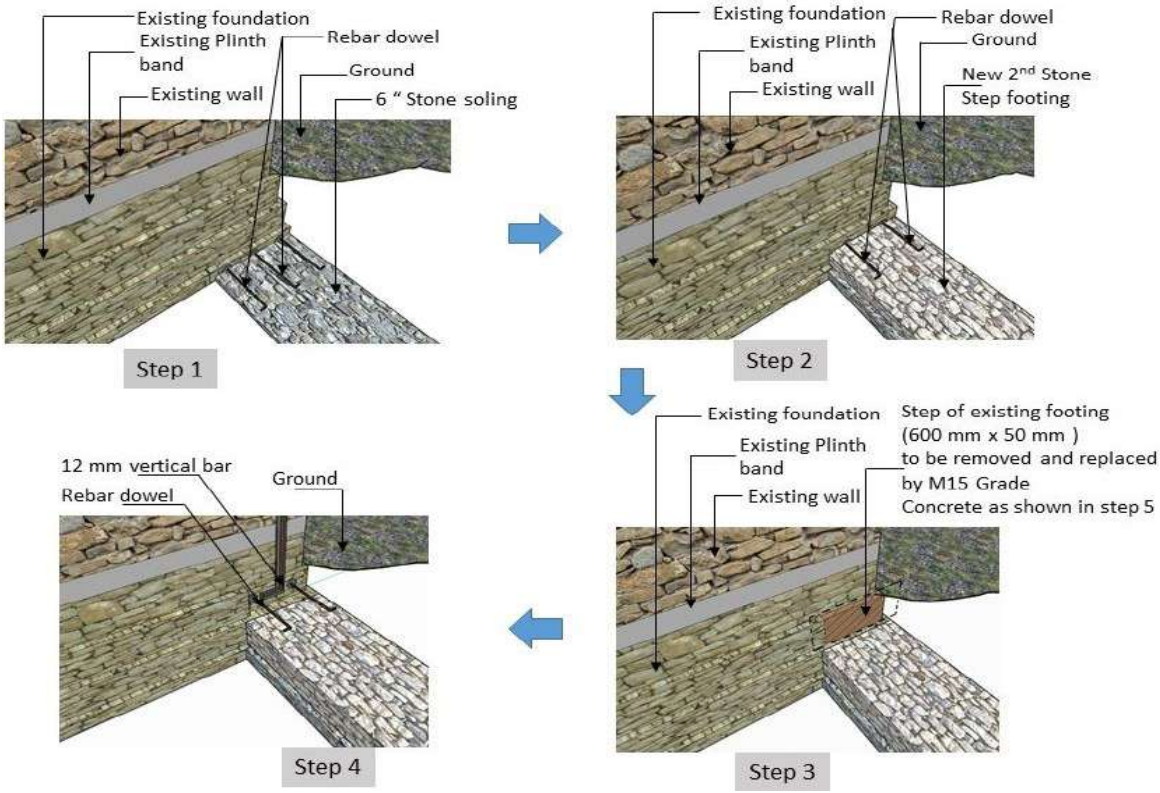
Figure 17. Typical connection details of Purlin and Ridge Beam to be followed while extending the roof

3.3 Construction Steps

The construction of the added room can be accomplished following the construction steps that are followed for the construction of a new building. However, the construction at the joint where the new wall and the existing wall meets has to follow the following procedures to ensure the connection between two walls/bands/stitches:

Case A: Existing bands of reinforced concrete

1. The foundation of new wall should be constructed as per specification of NNBC 202/203:2015. However, the connection of new and the existing foundation can be ensured following the steps depicted in Figure 18 below.
2. The plaster over the existing walls which forms interface with the new wall, bands and stitches shall be removed.
3. A vertical reinforcement bar shall be placed at the corner of new wall as shown in Figure 8 and Figure 18.
4. Connection between the existing foundation and the new foundation shall be provided as shown in Figure 18.
5. Construct the plinth band as suggested by NNBC. If the existing plinth band is of reinforced concrete, connect the new plinth band with the existing plinth band using the Band-Connectors as shown in Figures 12-16. In this case, it is not possible to provide Band-Connectors from every side, therefore, it is suggested to provide Band-Connectors wherever possible.
6. While progressing the construction of the new wall, integrity between the added and the existing wall should be provided employing the dowels as shown in Figure 10.



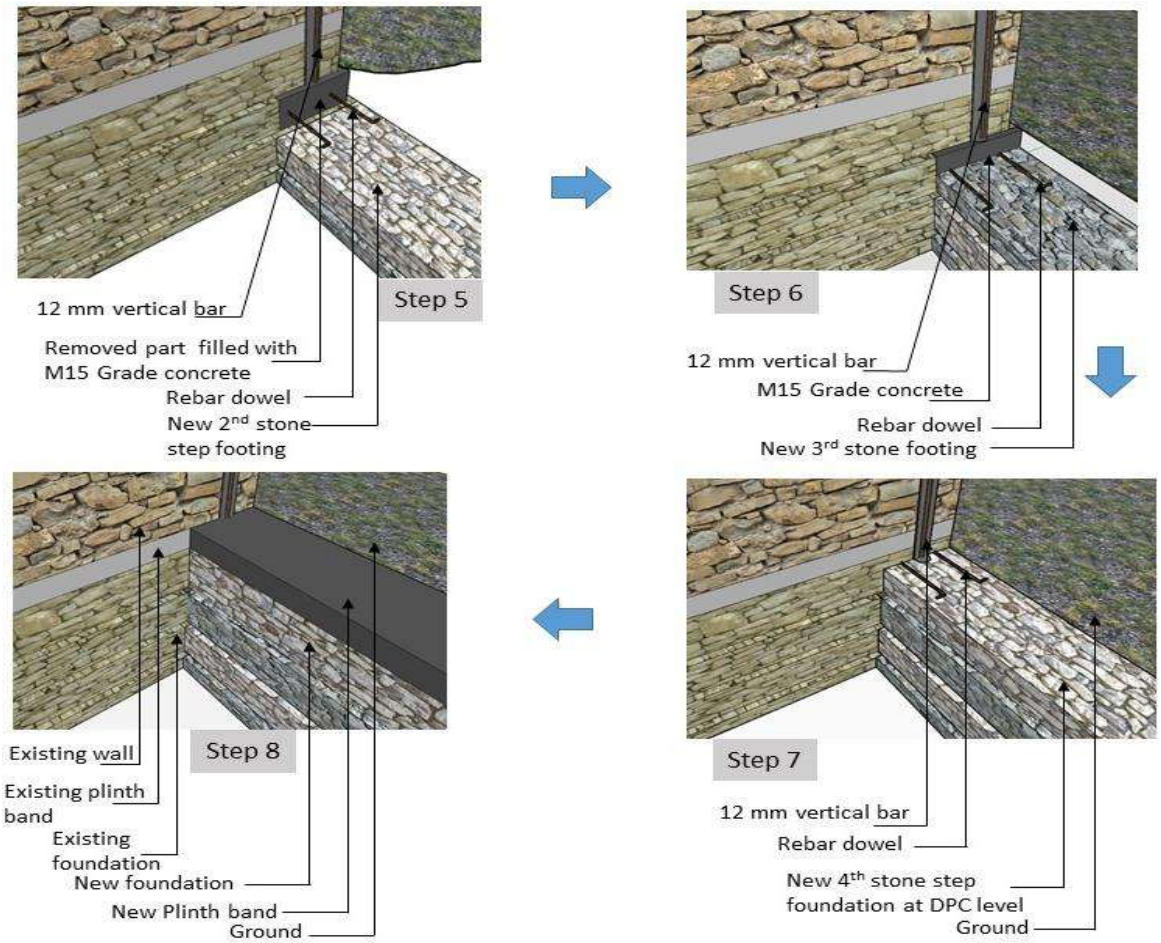


Figure 18. Typical details showing the connection between the existing foundation and new foundation (Case: concrete available)

7. A Band/stitch will be placed over the new walls at the level of a band/stitch of the existing walls. There should not be any discrepancy in the level between the existing band/stitch and the new band/stitch. Before casting a band/stitch, the connections between the reinforcements of a band/stitch and the Band-Connector should be ensured. This can be obtained by:

   a. 3-12 mm longitudinal reinforcements of the Band-Connector will be transversely tied using 8 mm ties at 150 mm c/c. These ties will be in vertical plane.

   b. Band-Connectors will be as per the requirements below:

i. In case of new walls:

Middle longitudinal reinforcements of the inner Band-Connector and the outer Band-Connector will be tied using 8 mm ties at 150 mm c/c (Refer Figure 12 and 14). These ties will be in horizontal plane. The horizontal plane of middle reinforcement of the Band-Connector will be in the same horizontal plane of the reinforcements of a band/stitch. This will be followed by casting of a band/stitch and the Band-Connector.

ii. In case of existing walls:

The presence of existing band/stitch hinders the provision of the same connection discussed just above in the case of new walls. Unlike the connections between inner and outer band-connectors provided in case of new walls, here, the connection between inner and outer band-

connectors will be done at the level of top and bottom reinforcements of band connectors (Refer Figure 12, 13 and 14). To achieve this, drilling in the existing wall is done at 200 mm c/c at the level of top reinforcements of band connectors. 4.75 mm through ties will be passed to connect top reinforcements of inner and outer band-connectors. This process will be repeated at the level of lower reinforcements of band-connectors. These through ties should be encased in 1: 3 mortar to protect them from corrosion.

8. The connection using the Band-Connector will be provided at every stitch/ band level.

   a. Special provision in case of RC Band-Connectors to be used over topmost band of a house

   Band-Connectors shown in Figure 12, 13 and 14 can be installed in other band levels except at the topmost band of house. The details of RC Band-Connectors to be used at the topmost band of a house are shown in the Annex.

   Special provision in case of RC Band-Connectors where there is presence of Kopla

   Koplas are common in case of 9" thick BMC walls. These presence hinder the placement of the RC Band-Connector depicted in Figure 12, 13 and 14. When such a situation comes, it is suggested to cast the modified RC Band-Connector of leg length 720 mm or 600 mm depending on the field situation as shown in Figure 15. The presence of Kopla hinders the continuation of longitudinal bars of Band-Connector. In such case, top and bottom bars of Band connectors can be made continuous withdrawing the brick units above and below the bands present in Kopla. However, it is not feasible to maintain the continuity of the middle reinforcement of Band-Connector as it encounters concrete band. Therefore, middle reinforcement will be embedded in existing band present in Kopla by an inch using rich cement mortar (1:3). The details are shown in the Annex.

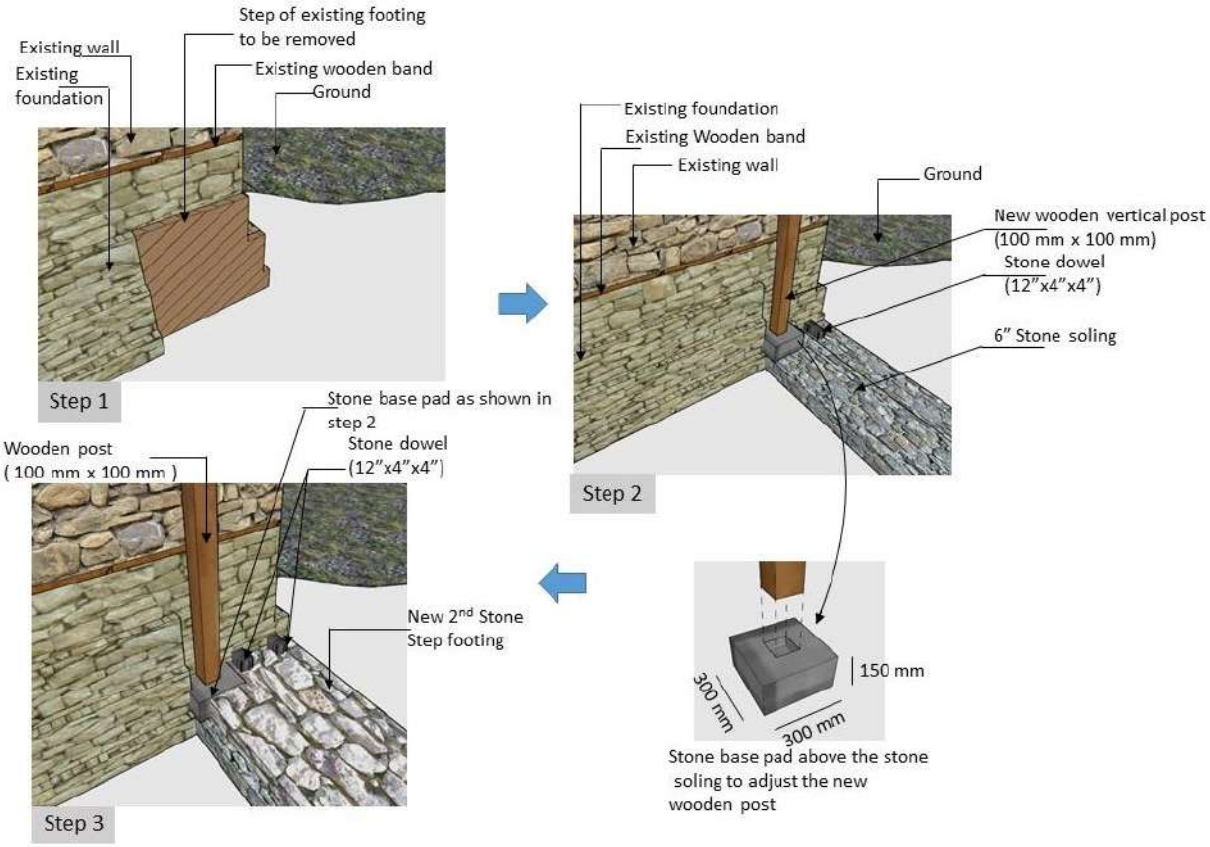
   b. Special provision in case of RC Band-Connectors where the available space will be limited to 600 mm

   The sample buildings that are referred to develop the Band-Connectors are the most prevalent buildings in the reconstructed area. In these buildings, the placement of Band-Connectors, of 720 mm leglength, will not have space constraint to be casted. However, NNBC allows that openings can be positioned at least 600 mm apart from the inner corner. Due to this provision, there can be a possibility for an opening to be located at 600 mm in one or both existing walls of some buildings. If this is the scenario, the Band-Connector of 720 mm cannot be placed due to limitation in space availability. In such positions only, a Band-Connector of 600 mm leg length can be used. The details of which is shown in the Annex. Therefore, there is a possibility of employing both Band-Connectors of leg length 720 mm and 600 mm in the same building as per the field conditions.

Case B: Existing bands of Timber

1. The foundation of new wall should be constructed as per specification of NNBC 202/203:2015. However, the connection of new and the existing foundation can be ensured following the steps depicted in Figure 19 below.
2. A vertical timber member shall be placed at the corner of new wall as shown in Figure 9.

3. While progressing the construction of the new wall, integrity between the added and the existing wall should be provided employing the dowels of stones as shown in Figure 11.
4. A Band/stitch will be placed over the new walls at the level of a band/stitch of the existing walls. There should not be any discrepancy in the level between the existing band/stitch and the new band/stitch. Here, the Band-Connector provided will be of metal strap as shown in the Figure 16.
5. The connection using the metal strap Band-Connector will be provided at every band: Plinth band, sill band, lintel band, stitches and roof band.



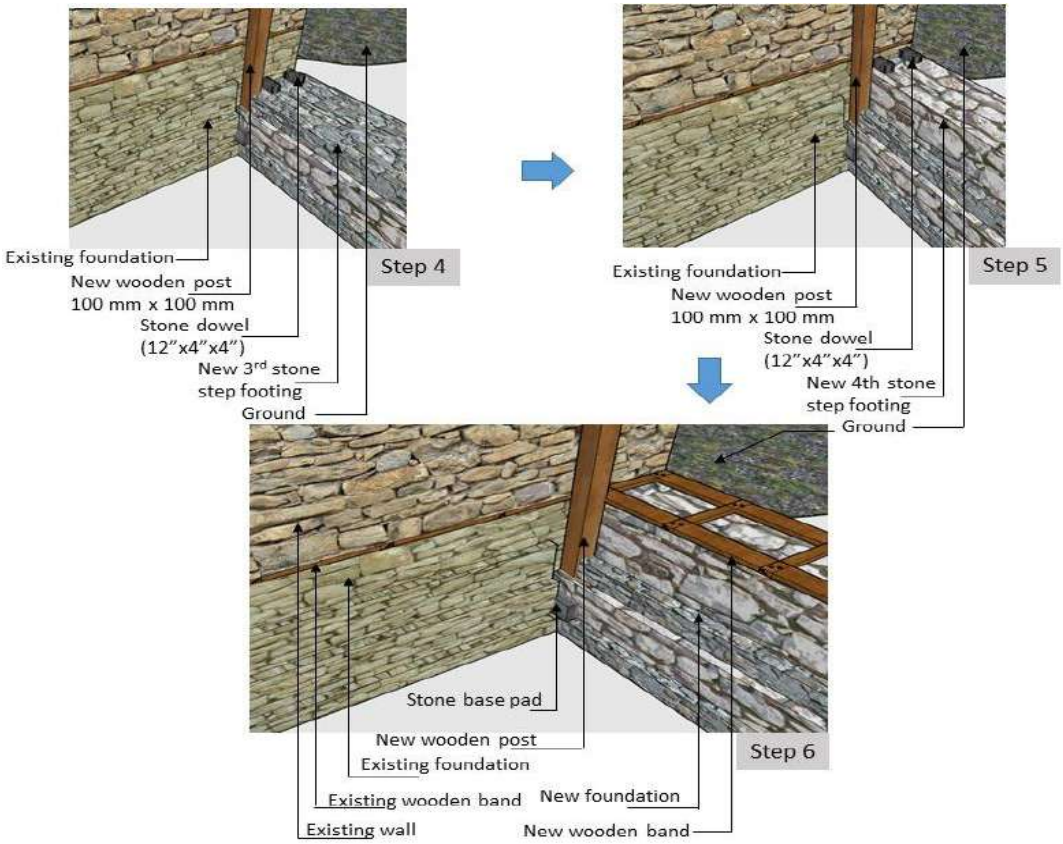


Figure 19. Typical details showing the connection between the existing foundation and new foundation (Case: concrete unavailable)

4 ALTERNATIVE METHOD FOR HORIZONTAL EXTENSION:

In addition to the horizontal extension discussed above, horizontal extension can be done stiffening the new wall with the aid of buttresses. In this method, Band-Connectors need not have to be provided to connect the existing wall and new wall as the provision of buttresses stiffens the new wall.

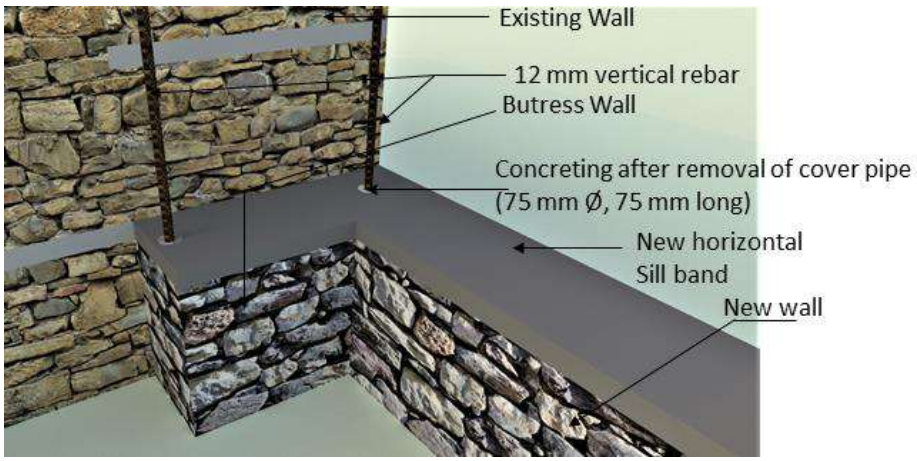


Figure 20. Provision of buttress to stiffen the new wall where cement and reinforcement are available in case of Stone masonry

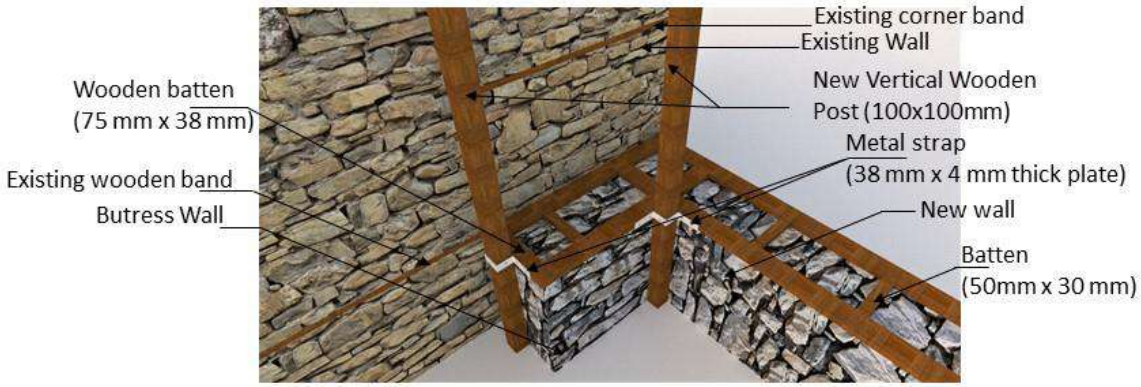


Figure 21. Provision of buttress to stiffen the new wall where cement and reinforcement are not available in case of Stone masonry

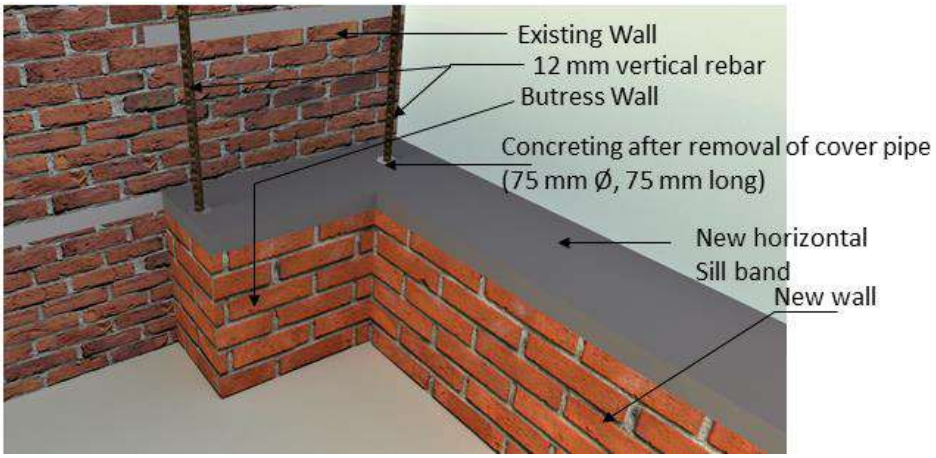


Figure 22. Provision of buttress to stiffen the new wall where cement and reinforcement are available in case of brick masonry

As this method does not employ the Band-Connector, there will not be any outward projection of Band-Connector which makes the facade of masonry looks more aesthetic in this case than the extension done using the Band-Connector. However, the application of buttresses occupies more usable space of room. Among the horizontal extensions discussed above, this method is feasible for:

a. Addition of a room at one of the widths
b. Addition of two rooms at one of the lengths

The 3D views of above two case are presented below:

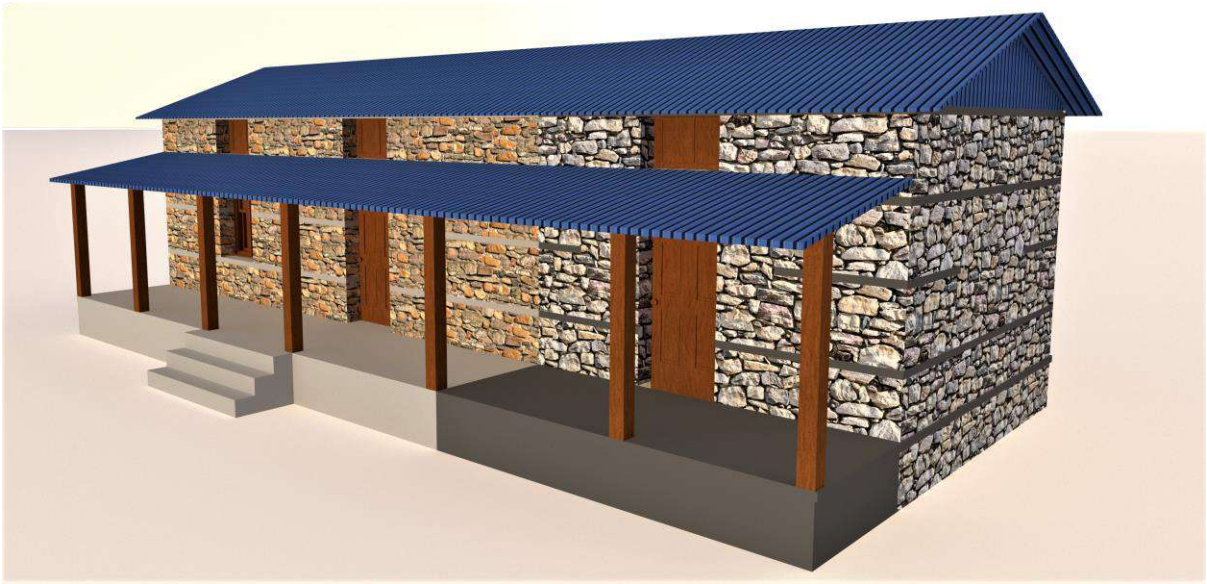


Figure 23. Addition of a room at one of the widths with the provision of buttresses in case of stone in mud building

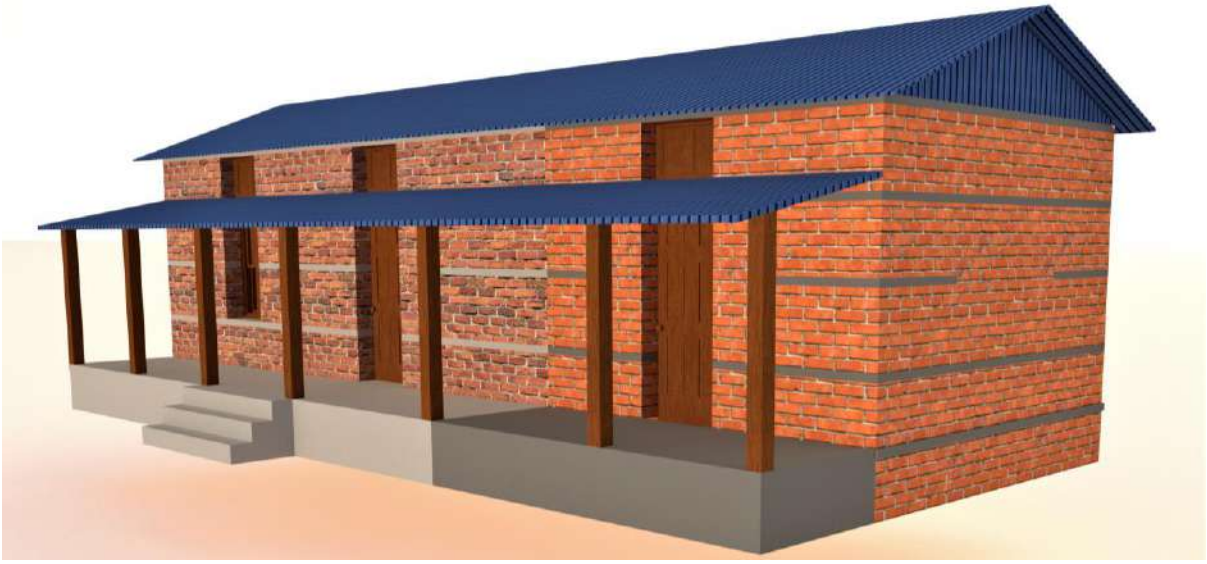


Figure 24. **Addition of a room at one of the widths with the provision of buttresses in case of brick in cement building**

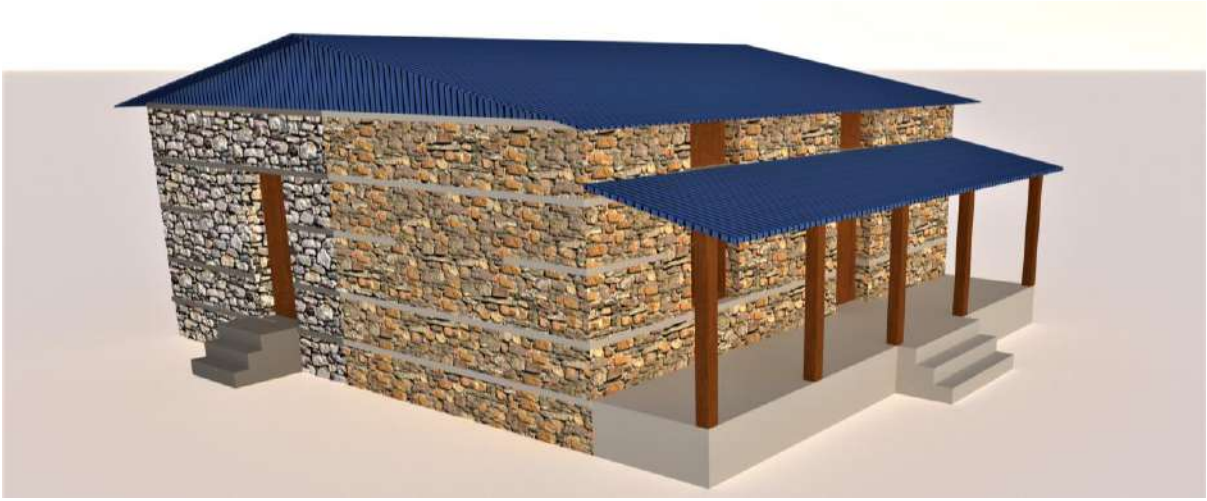


Figure 25. **Addition of two rooms at one of the lengths with the provision of buttresses in case of stone in mud building**

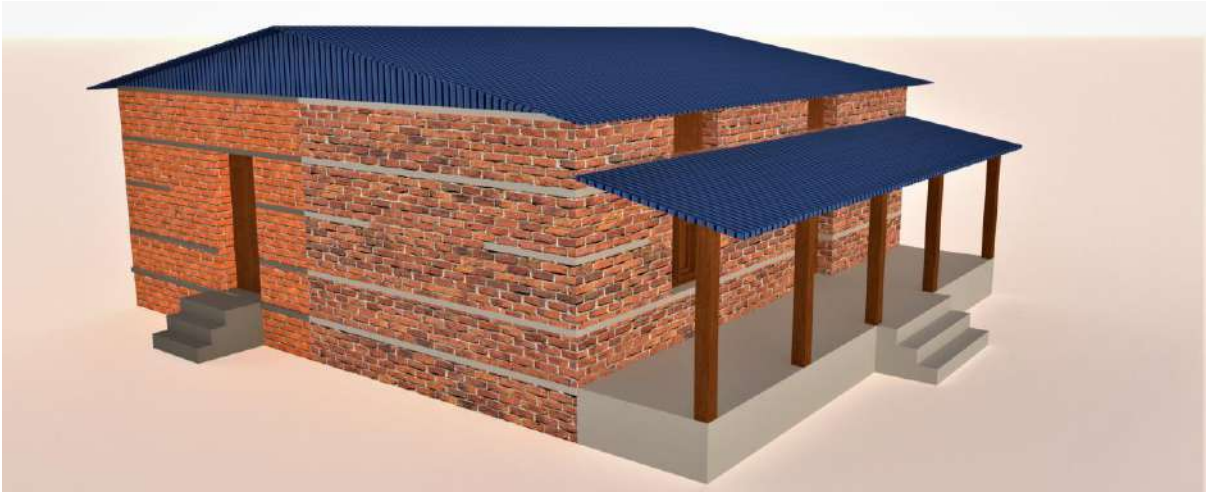


Figure 26. **Addition of two rooms at one of the lengths with the provision of buttresses in case of brick in cement building**

5 VERTICAL EXTENSION

Vertical Extensions are mainly proposed in such cases where there is not enough land or owners do not prefer to add rooms horizontally any further. The extension in such cases is primarily governed by the load carrying capacity of the existing main structure. Vertical extensions are possible in the case where the main structure (existing ground storey structure) satisfies the requirements stated in NNBC for the final structure that results after a vertical extension. Competent Technical Personnel shall recommend the feasible vertical extension judging the followings:

1. The existing building should have
    a. been reconstructed under the Housing Reconstruction Program of the Government of Nepal, National Reconstruction Authority (NRA) and,
    b. been inspected and approved for all three tranches of government grant support and certified for completion by the NRA
2. The existing building structure or components of the building has not undergone any structural damage or problems related to settlement, tilting of walls and so forth.

(In case of structural problems in the structure, extension using this guideline is not recommended. However, a competent engineer can recommend the best alternative to extend, if possible, studying the severity of the problem.)

3. The existing foundation depth and width suffices the requirements of the building resulting after the extension.

The existing walls of the ground storey have the minimum thickness that NNBC states for the building structure resulting after the extension.

4. The size of the verticals used in critical sections of the existing building have a minimum dimension that NNBC states in the ground storey of two storied buildings.

In case of buildings that do not meet the structural requirements as suggested above (3, 4 and 5), the structural capacity will not suffice to support the addition of storey using the parent material used in the ground storey. If this is the scenario but the house owner is in a dire need of a vertical extension, an extension in the vertical direction can be proposed using lightweight materials following the design requirements in the Hybrid Manual published by the National Reconstruction Authority. Apart from that, an addition of a storey using the parent material can be done after carrying out the structural improvement of the existing building structure following the design provided by a competent engineer/designer.

In case of buildings satisfying the above requirements, a few feasible options are discussed here.

5.1 Possible vertical extension

The feasible vertical extensions for brick and stone masonry structures are listed in Table 1 below. Possible modes of vertical extension/ modification in brick and stone masonry buildings

Table 1: Possible vertical extension of buildings with respect to building typology

S.N.	Existing Building Typology	Possible Extension/Modification as per NNBC
1	Building in Cement Mortar	a. Addition of an attic using the same parent material b. Addition of a storey using the same parent material c. Addition of a storey and an attic using the same parent material d. Addition of a storey using light materials
2	Building in Mud Mortar	a. Addition of an attic b. Addition of a storey using light materials
3	Changing the roof	a. Replacing light roof with RC roof

5.1.1 Addition of a floor in the case of cement mortar:

If the mortar used while constructing the ground story is cement mortar, addition of a story, or a story and attic is allowed according to Nepal National Building Code. However, the following requirements stated by NNBC-202/2015 should be fulfilled by the existing ground storey for an addition of a storey using the same parent material, otherwise a vertical extension using the same parent material will not be a feasible option.

Table 2: MRs to extend vertically using the same parent material

		Stone Masonry in Cement (SMC)	Brick Masonry in Cement (BMC)
Existing wall thickness of ground storey, mm		350	350
Existing Base width of footing	Soft soil, mm	*	900
	Medium Soil, mm	800	650
	Hard Soil, mm	600	550
Existing Depth of footing, mm		900	900
Diameter of vertical reinforcement bars used in critical sections of the existing ground storey, mm		16	16

*** Two-storied buildings with load-bearing stone masonry of random rubble or half-dressed stone are not recommended in soft soil**

If any of the Minimum Requirements stated above is not fulfilled, it is not recommended to extend vertically using the same parent material, the feasible option here will be extending vertically using light structures following the Hybrid Manual, endorsed by NRA, GoN.

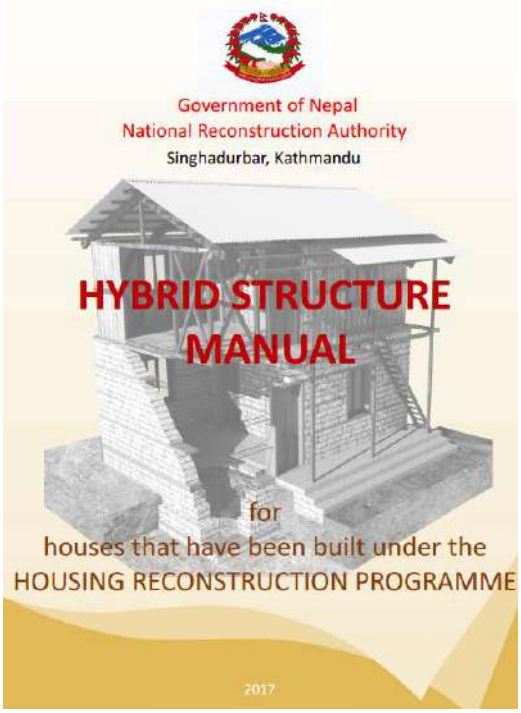


Figure 27. Hybrid Structure Manual

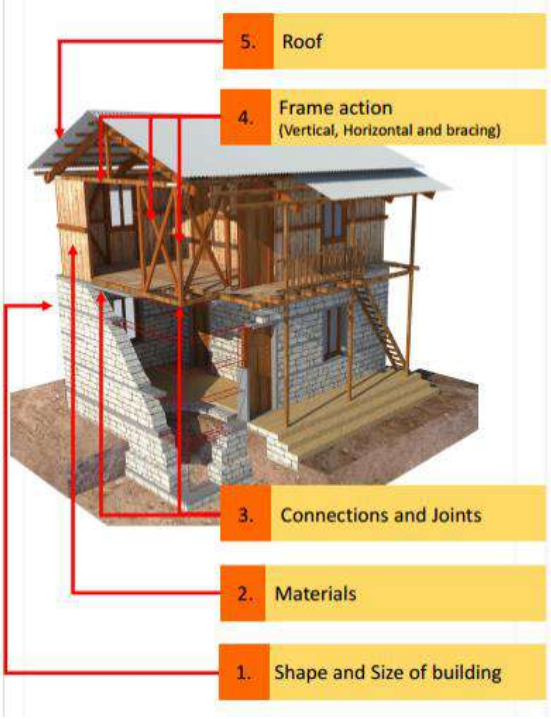


Figure 28. Key elements of Hybrid structure (Reference: Hybrid Structure Manual, NRA, GoN)

The Hybrid Structure Manual presents the implementable methods of extending the house vertically using light frame members, especially timber frames as shown in figures 27 and 28 above. It focuses on the use of timber members as frames and cladding using wooden planks, CGI sheets and so forth. It exhaustively discusses the connection between the existing structure and the new structure, and the connection between their components.

However, if houseowner wants to extend vertically the house, which does not satisfy MRs, presented in Table 2, using the same parent material (brick or stone), they can seek a competent engineer to retrofit/ strengthen the existing storey of the house before extending the house vertically.

Whereas if the ground storey satisfies the Minimum Requirements mentioned above, a vertical extension is possible using the same parent material. This can be done simply following the NNBC, however, there can be a challenge regarding the continuity of the vertical rebars. This can be ensured following the following procedures:

- Dismantle the existing roof so attentively that the same holes in the CGI sheets can be used again. This will prevent the leakage from the roof. For this, masons can number the CGI sheets before dismantling and fit them using the same number order when they must assemble again after constructing the attic.
- Disassemble other components of the roof cautiously so that these elements can be used again.
- The vertical rebars coming from ground story, which used to be bent round the wall plate, roof band should be straightened, and this straightened reinforcement should be employed to provide the lapping. Lapping should not be less than 60 times the diameter of the verticals. If the reinforcement coming from the ground story, which was bent over the wall plate or roof

band, is less than 60 times the diameter of the verticals, it is recommended to drill through the roof band and take out the units below the roof band from the wall at corners, jambs of the openings and at where there are verticals coming from the ground story so that sufficient lapping can be done.

- After ensuring the continuity of the verticals, the procedures that is used to construct a new storey can be followed

5.1.2 Addition of floor in the case of mud mortar

1. If the single storied houses were built in mud mortar, they can have an attic extended provided that these houses consist of RC bands, whereas those houses consisting of wooden bands are not recommended to have an addition of an attic. The addition of an attic can be done simply following the NNBC, however, the key challenge is to maintain the continuity of the existing vertical rebar which can be ensured following the same steps discussed in section above.
2. If the mortar involved while constructing the ground story is low strength mortar (mud mortar), addition of a story is not allowed as per National Nepal Building Code. However, the guideline 'Hybrid Structure Manual' prepared by National Reconstruction Authority, Government of Nepal allows the addition of a story using light materials, such as CGI sheets, timber. Hence, those house owners who have constraints to extend horizontally can extend vertically following the Hybrid Structure Manual if they need additional rooms.

5.1.3 Replacing light roofing with RC roofing

This option is feasible in case of strong mortar (cement mortar). NNBC do not recommend the use of heavy roof in case of low strength mortar. The replacement of light roofing with RC Roof can be accomplished following the NNBC.

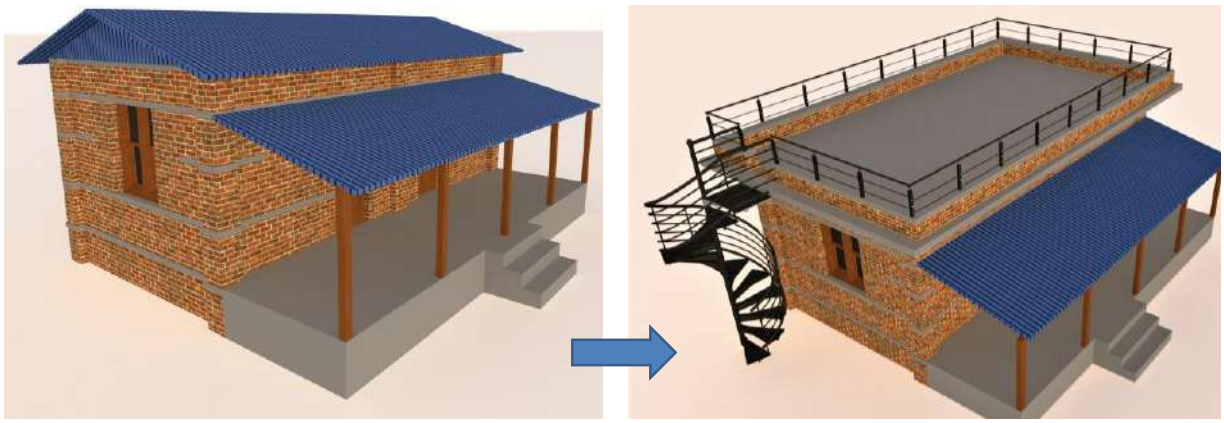


Figure 29. Showing the transformation of the building after replacing light roof with RC roof

6 REFERENCES:

NNBC105: 1994, Seismic Design of Buildings in Nepal

NNBC 203: 2015, Guidelines for Earthquake Resistant Building Construction: Low Strength Masonry

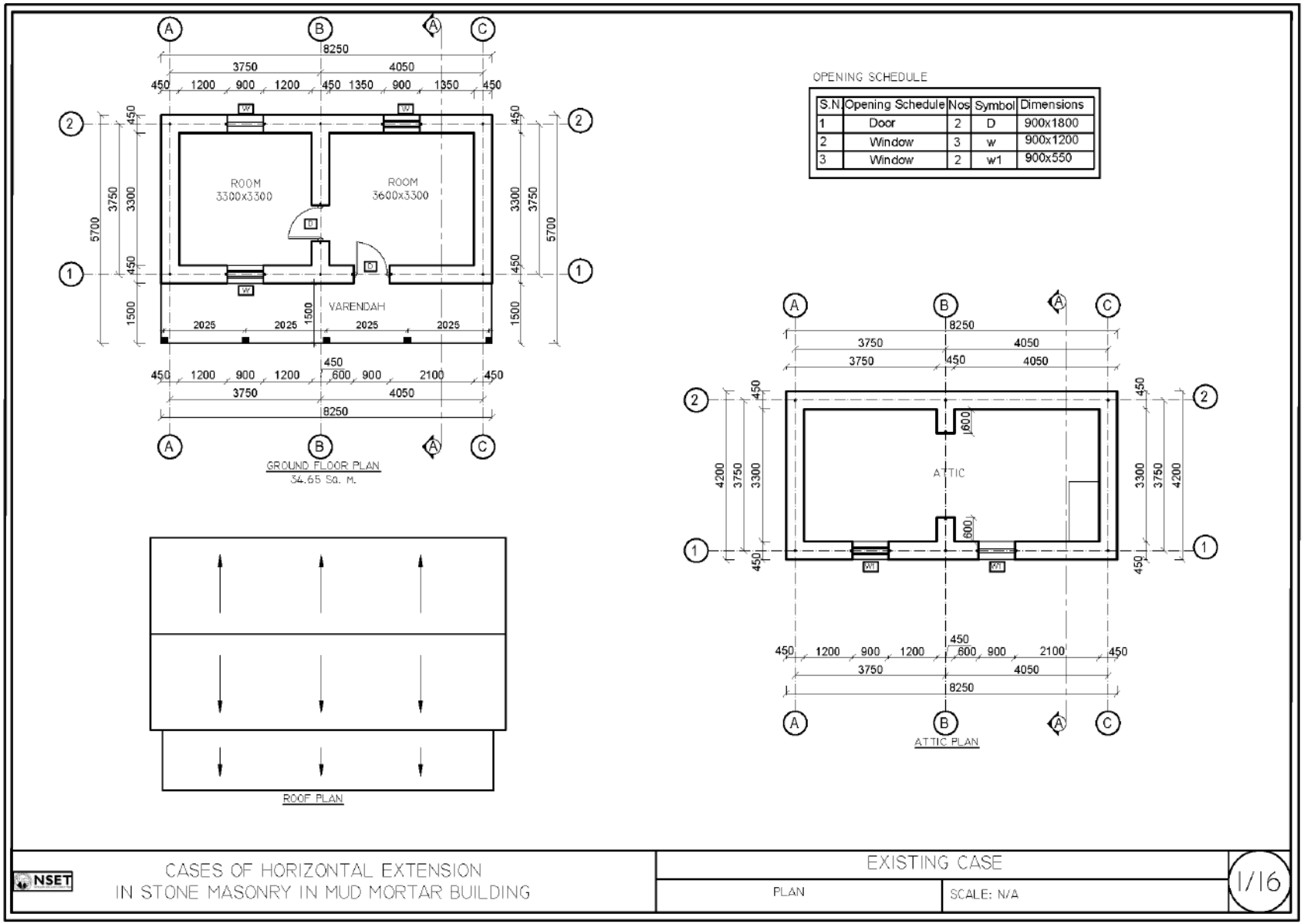
NNBC 202: 2015, Guidelines on: Load Bearing Masonry

Correction/Exception Manual for Masonry Structure for Houses that have been Built Under the Housing Reconstruction Programme

Hybrid Structure Manual for Houses that have been Built under the Housing Reconstruction Programme

How to Extend your House Safely, Part A: A Guide for Extending your House at the Ground Floor, Prepared by United Nations Development Programme (UNDP)

ANNEXES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S.N. Opening Schedule Nos Symbol Dimensions
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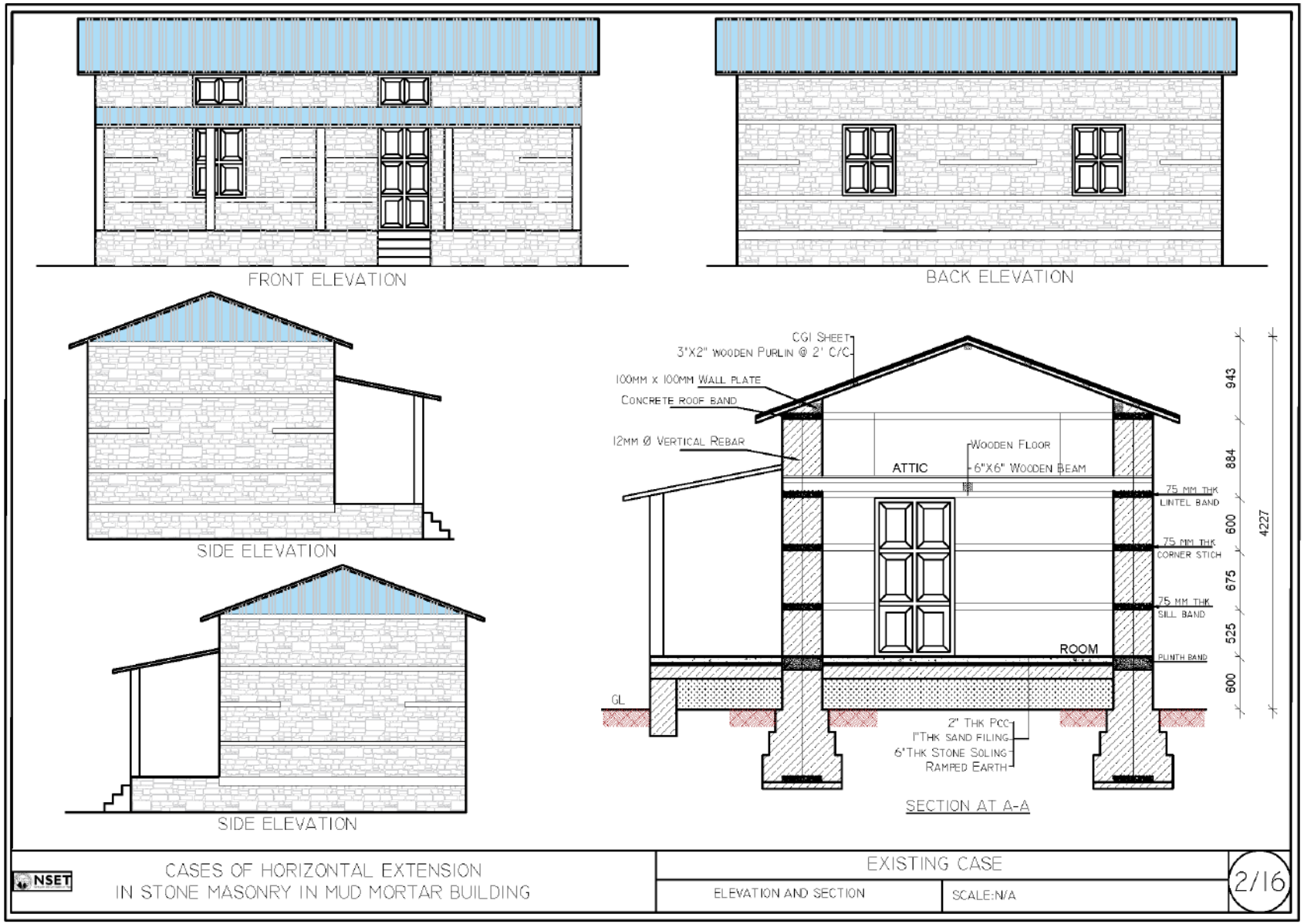
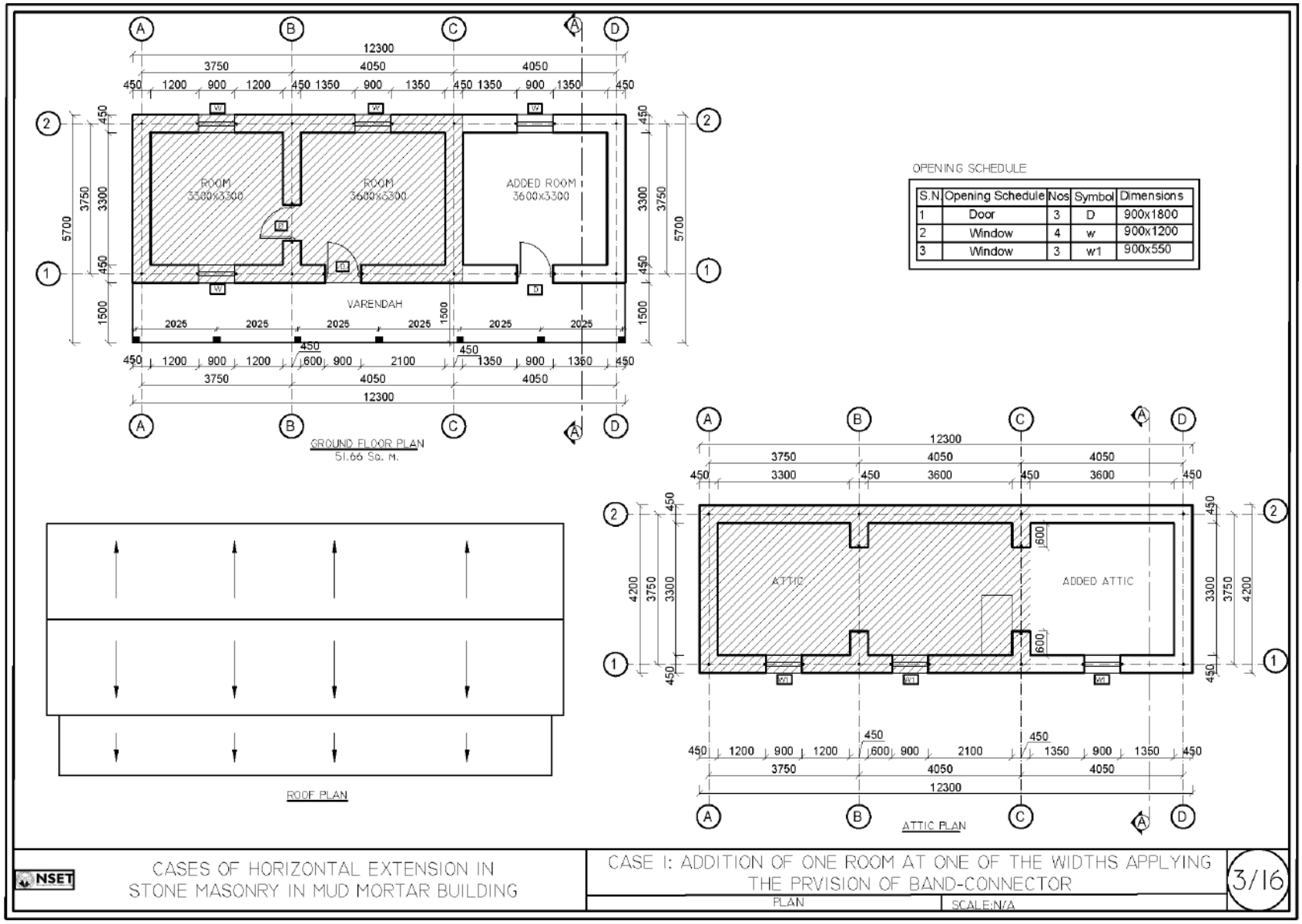
2 Window 3 w 900x1200
3 Window 2 w1 900x550
ROOM 3300x3300
ROOM 3600x3300
VARENDAH
GROUND FLOOR PLAN
34.65 Sq. M.
ROOF PLAN
ATTIC
ATTIC PLAN
NSET
CASES OF HORIZONTAL EXTENSION
IN STONE MASONRY IN MUD MORTAR BUILDING
EXISTING CASE
PLAN
SCALE: N/A
1/16


FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
CGI SHEET
3"X2" WOODEN PURLIN @ 2' C/C
100MM x 100MM WALL PLATE
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
WOODEN FLOOR
6"X6" WOODEN BEAM
ATTIC
ROOM
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
PLINTH BAND
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
943
884
600
675
525
600
4227
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION
IN STONE MASONRY IN MUD MORTAR BUILDING
EXISTING CASE
ELEVATION AND SECTION
SCALE:N/A
2/16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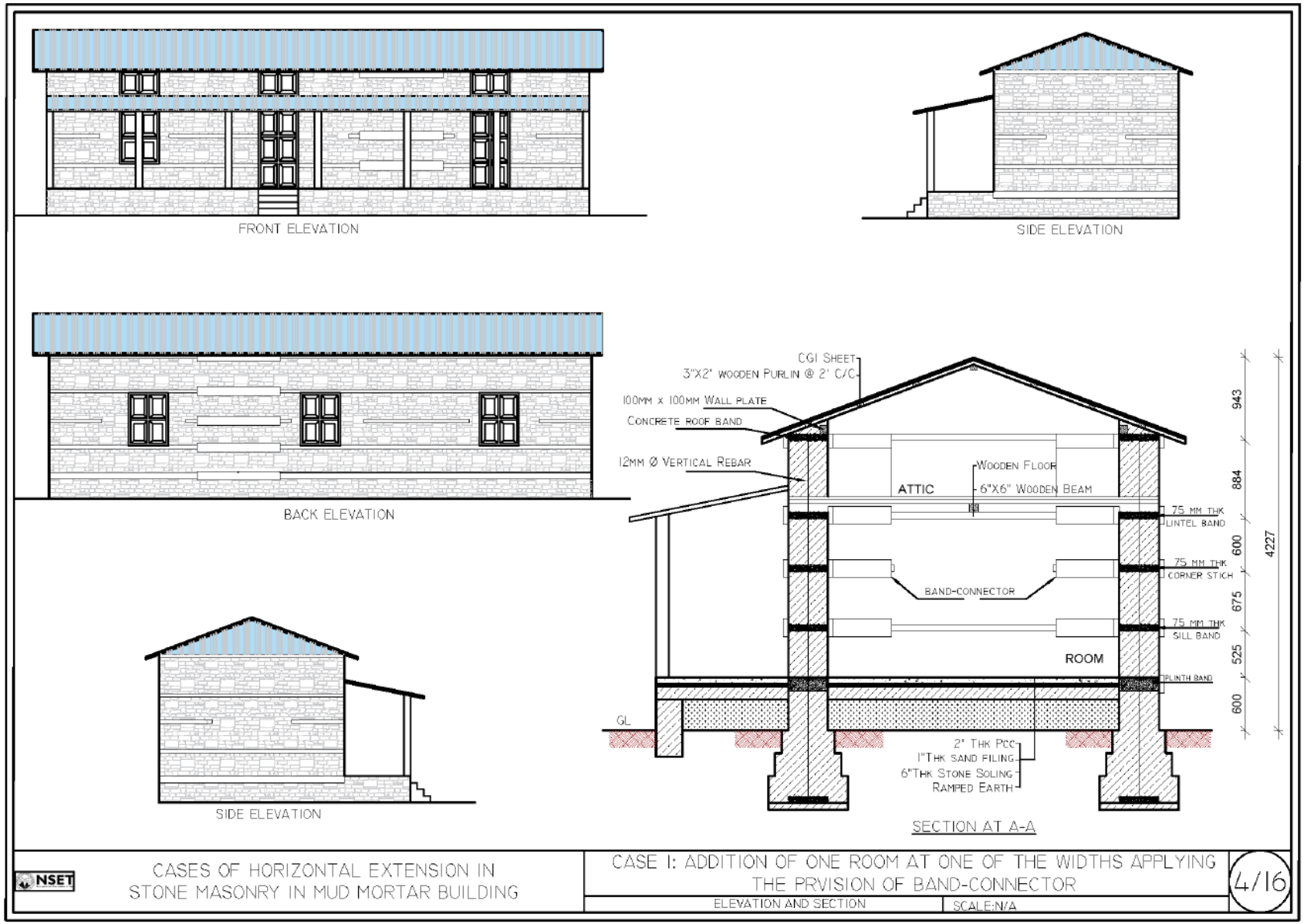
3750
4050
4050
ROOM
3300x3300
ROOM
3600x3300
ADDED ROOM
3600x3300
VARENDAH
GROUND FLOOR PLAN
51.66 Sq. M.
OPENING SCHEDULE
S.N. Opening Schedule Nos. Symbol Dimensions
1 Door 3 D 900x1800
2 Window 4 w 900x1200
3 Window 3 w1 900x550
ROOF PLAN
ATTIC
ADDED ATTIC
ATTIC PLAN
CASES OF HORIZONTAL EXTENSION IN
STONE MASONRY IN MUD MORTAR BUILDING
CASE I: ADDITION OF ONE ROOM AT ONE OF THE WIDTHS APPLYING
THE PRVISION OF BAND-CONNECTOR
PLAN
SCALE:N/A
3/16


FRONT ELEVATION
SIDE ELEVATION
BACK ELEVATION
SIDE ELEVATION
CGI SHEET
3"X2" WOODEN PURLIN @ 2' C/C
100MM x 100MM WALL PLATE
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
WOODEN FLOOR
6"X6" WOODEN BEAM
ATTIC
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
BAND-CONNECTOR
75 MM THK SILL BAND
ROOM
PLINTH BAND
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
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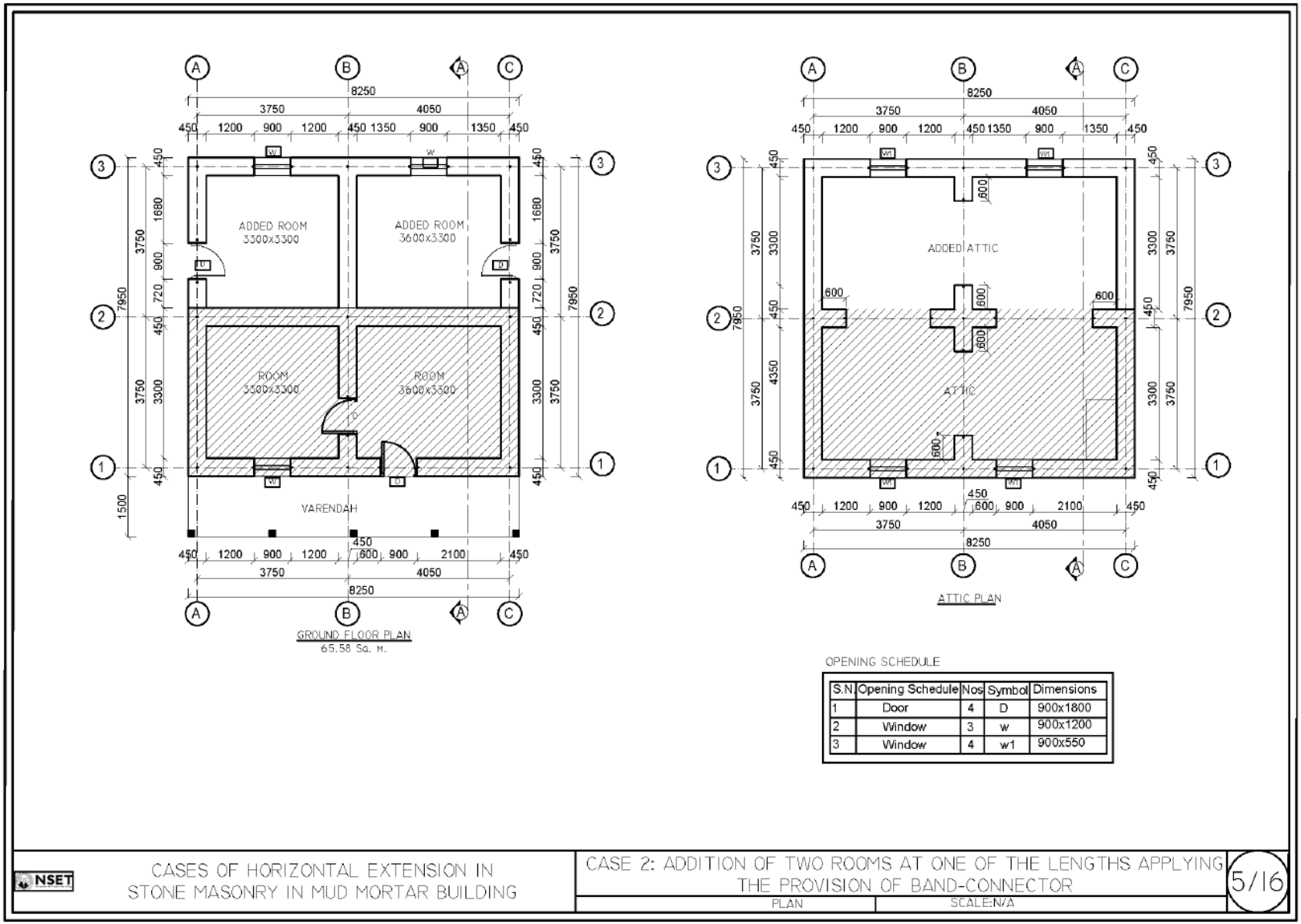
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION IN
STONE MASONRY IN MUD MORTAR BUILDING
CASE I: ADDITION OF ONE ROOM AT ONE OF THE WIDTHS APPLYING
THE PRVISION OF BAND-CONNECTOR
ELEVATION AND SECTION
SCALE:N/A
4/16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3300x3300
ADDED ROOM
3600x3300
ROOM
3300x3300
ROOM
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VARENDAH
GROUND FLOOR PLAN
65.58 Sq. M.
ADDED ATTIC
ATTIC
ATTIC PLAN
OPENING SCHEDULE
S.N. | Opening Schedule | Nos | Symbol | Dimensions
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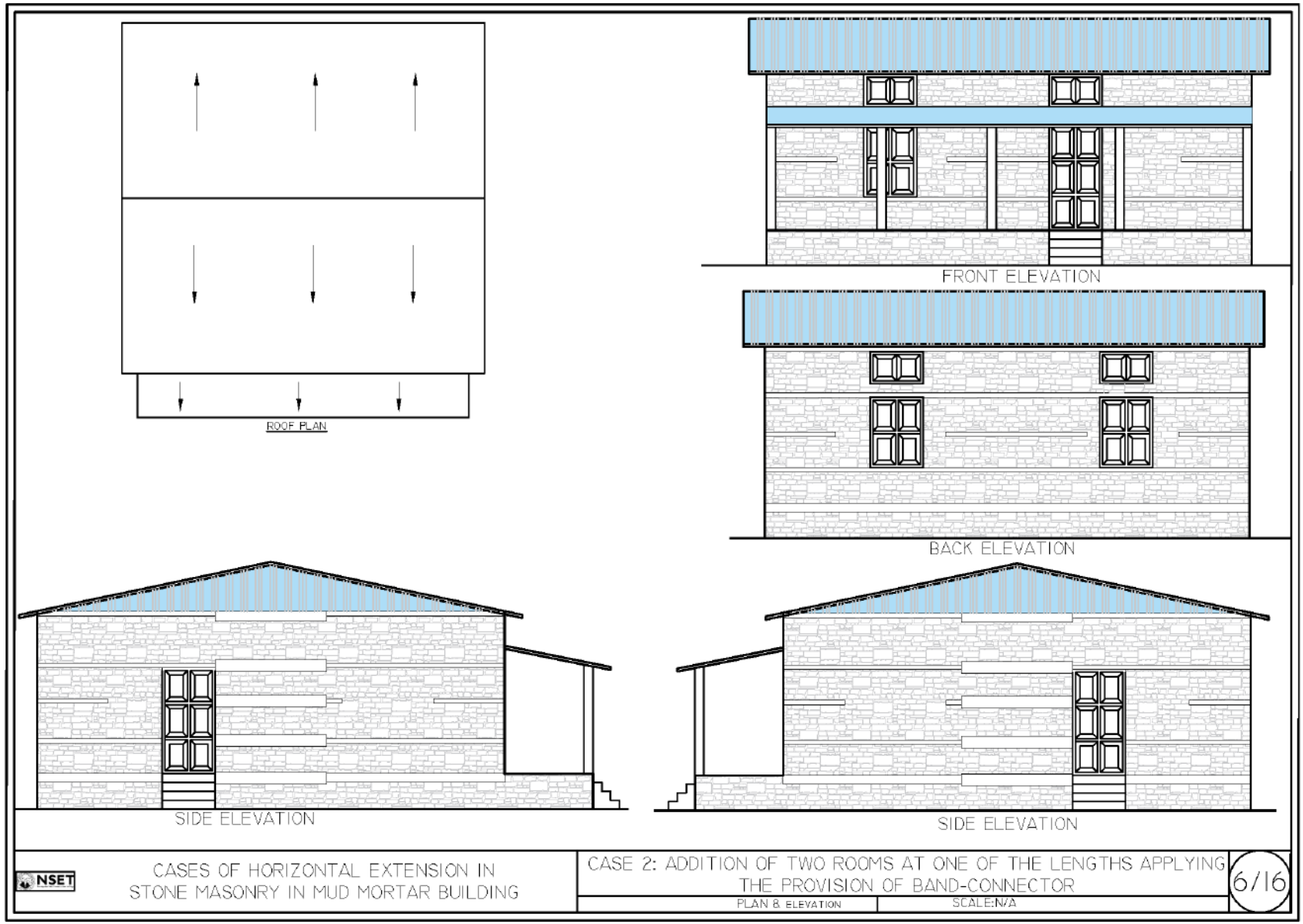
2 | Window | 3 | w | 900x1200
3 | Window | 4 | w1 | 900x550
NSET
CASES OF HORIZONTAL EXTENSION IN
STONE MASONRY IN MUD MORTAR BUILDING
CASE 2: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS APPLYING
THE PROVISION OF BAND-CONNECTOR
PLAN
SCALE:N/A
5/16


ROOF PLAN
FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
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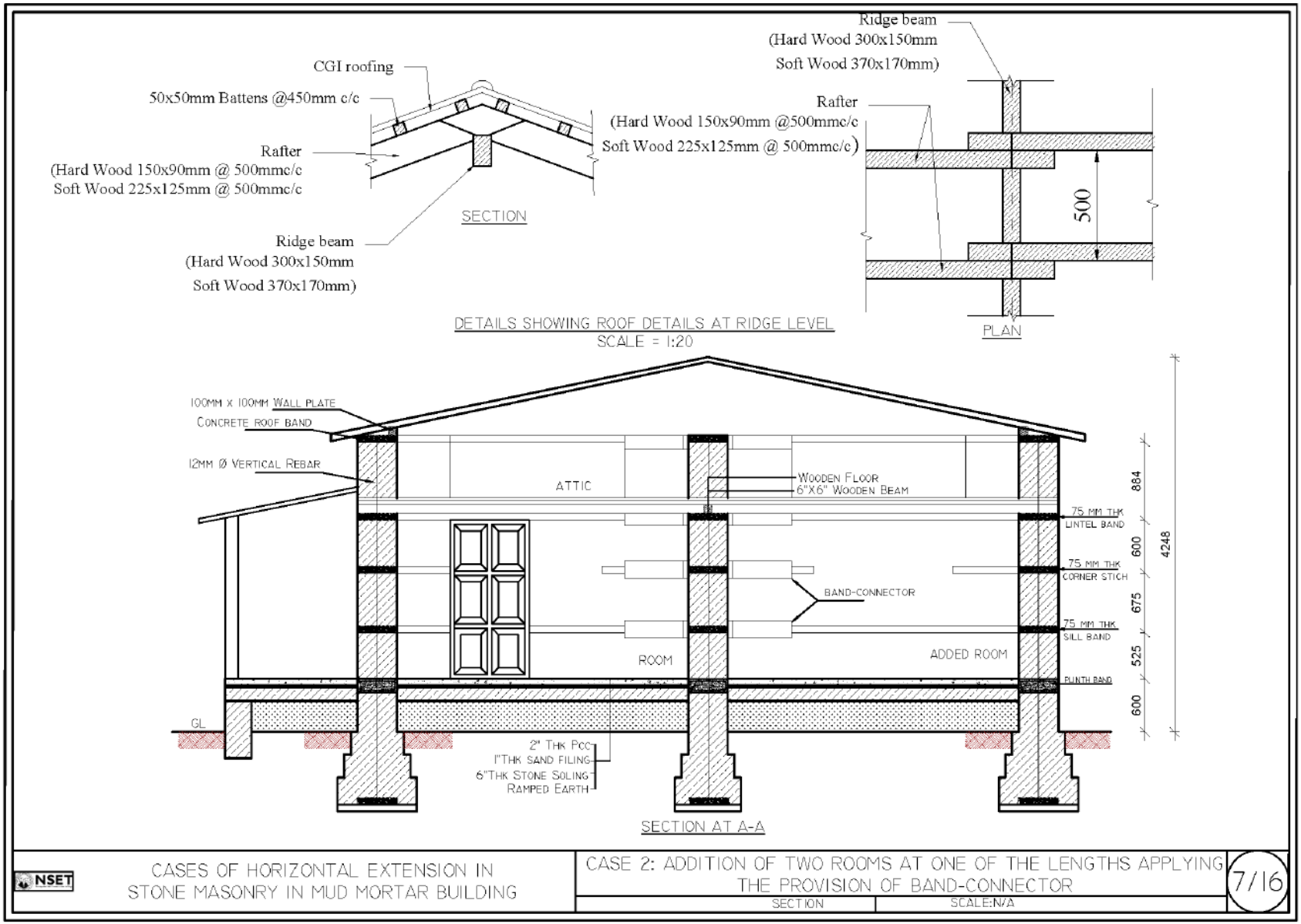
CASES OF HORIZONTAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
CASE 2: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS APPLYING THE PROVISION OF BAND-CONNECTOR
PLAN & ELEVATION
SCALE:N/A
6/16


CGI roofing
50x50mm Battens @450mm c/c
Rafter
(Hard Wood 150x90mm @ 500mmc/c
Soft Wood 225x125mm @ 500mmc/c
Ridge beam
(Hard Wood 300x150mm
Soft Wood 370x170mm)
SECTION
Ridge beam
(Hard Wood 300x150mm
Soft Wood 370x170mm)
Rafter
(Hard Wood 150x90mm @500mmc/c
Soft Wood 225x125mm @ 500mmc/c)
500
PLAN
DETAILS SHOWING ROOF DETAILS AT RIDGE LEVEL
SCALE = 1:20
100MM x 100MM WALL PLATE
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
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6"X6" WOODEN BEAM
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BAND-CONNECTOR
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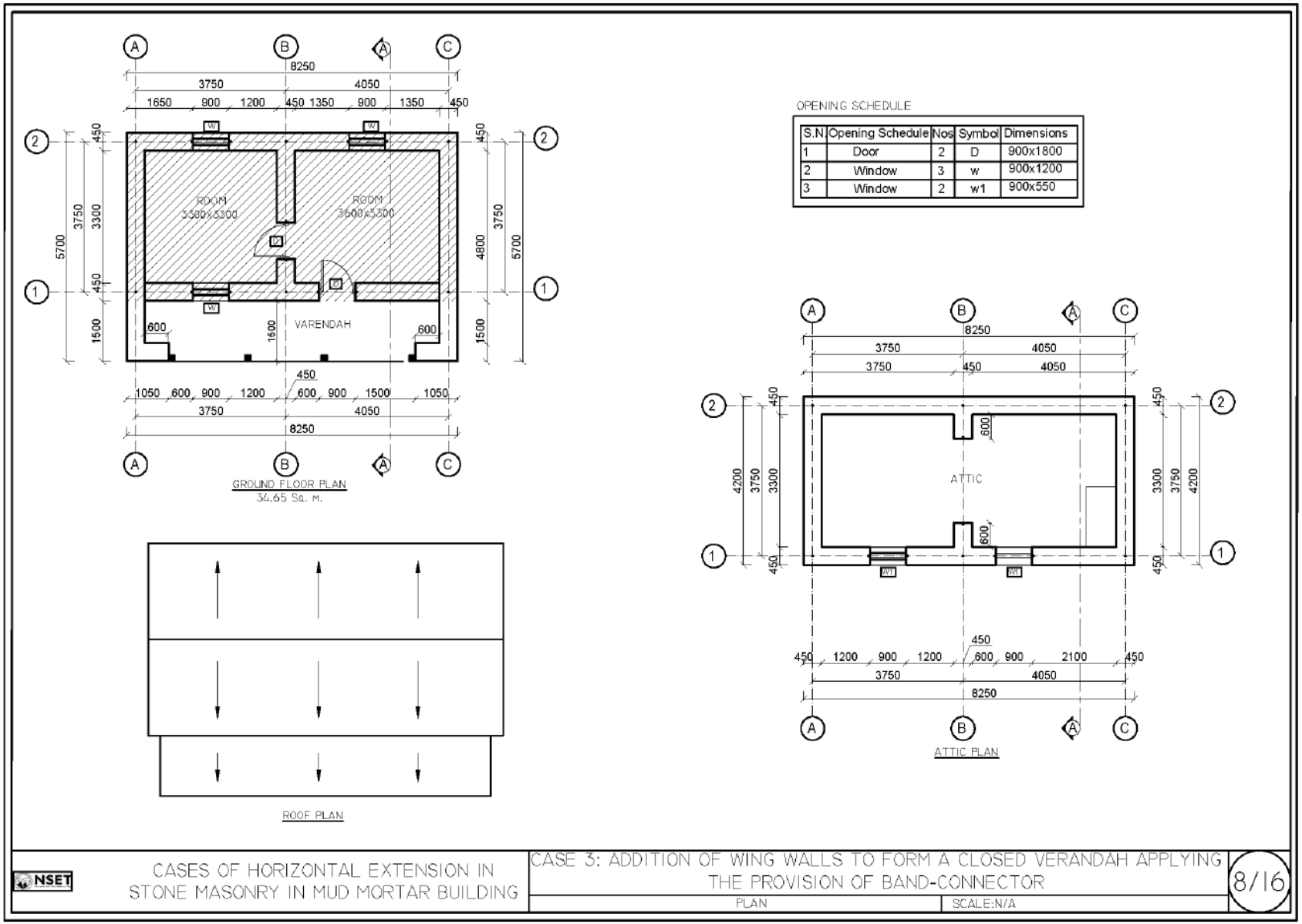
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION IN
STONE MASONRY IN MUD MORTAR BUILDING
CASE 2: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS APPLYING
THE PROVISION OF BAND-CONNECTOR
SECTION
SCALE:N/A
7/16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S.N. Opening Schedule Nos Symbol Dimensions
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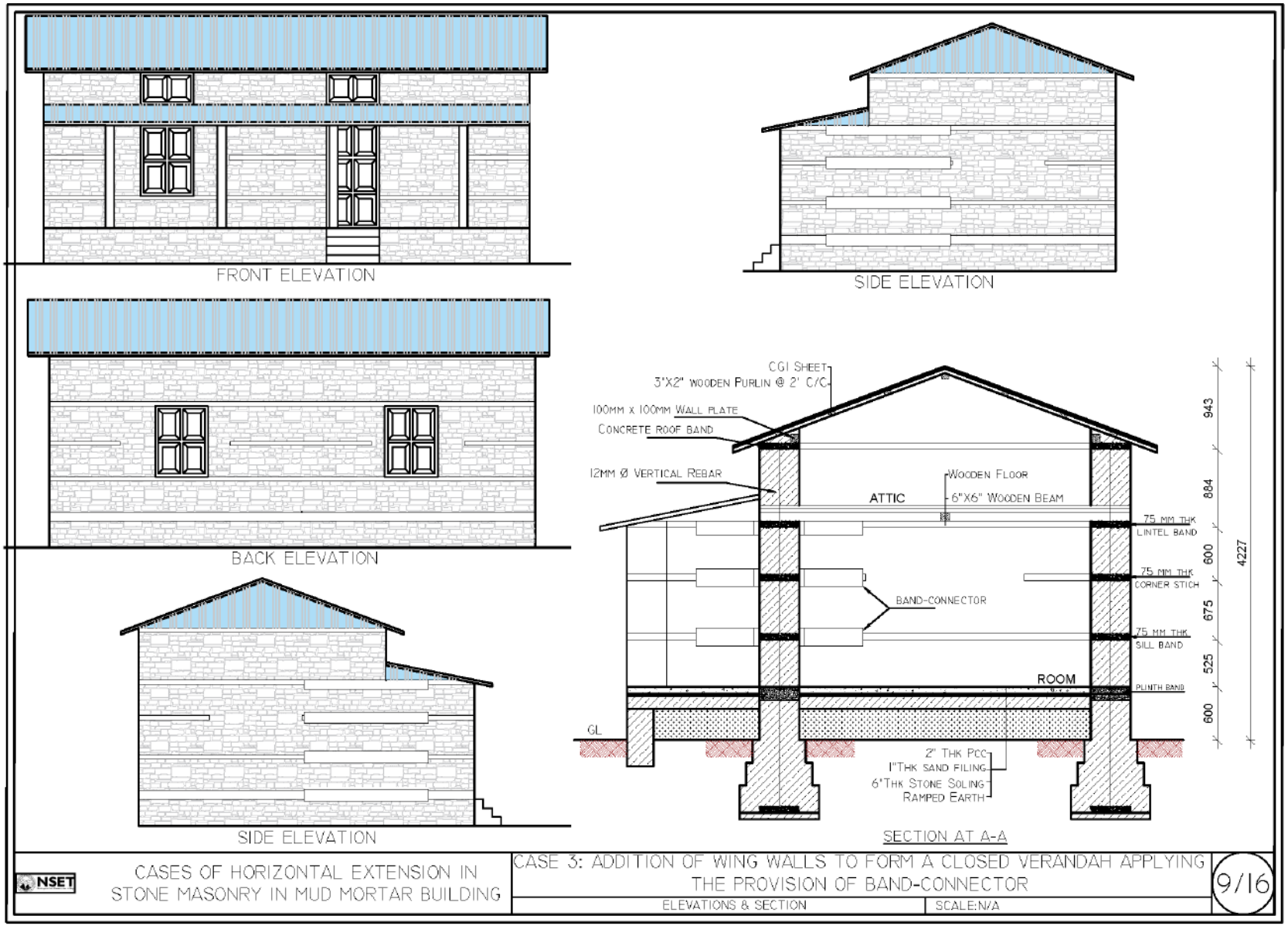
2 Window 3 w 900x1200
3 Window 2 w1 900x550
ROOM 3300x3300
ROOM 3600x3300
VARENDAH
GROUND FLOOR PLAN
34.65 Sq. M.
ATTIC
ATTIC PLAN
ROOF PLAN
CASES OF HORIZONTAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
CASE 3: ADDITION OF WING WALLS TO FORM A CLOSED VERANDAH APPLYING THE PROVISION OF BAND-CONNECTOR
PLAN
SCALE:N/A
8/16


FRONT ELEVATION
SIDE ELEVATION
BACK ELEVATION
SIDE ELEVATION
CGI SHEET
3"X2" WOODEN PURLIN @ 2' C/C
100MM x 100MM WALL PLATE
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
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WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
BAND-CONNECTOR
75 MM THK SILL BAND
ROOM
PLINTH BAND
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
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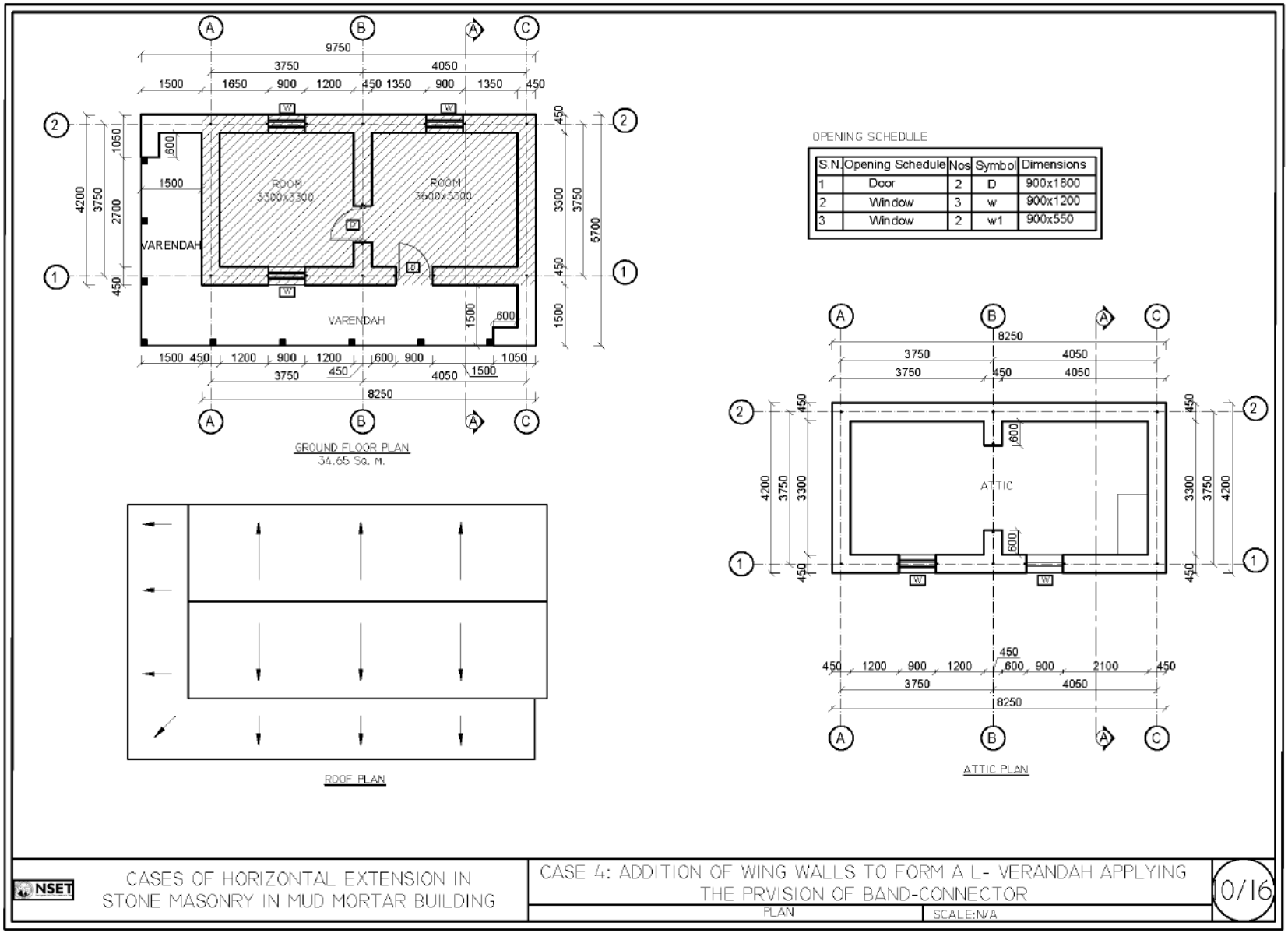
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
CASE 3: ADDITION OF WING WALLS TO FORM A CLOSED VERANDAH APPLYING THE PROVISION OF BAND-CONNECTOR
ELEVATIONS & SECTION
SCALE:N/A
9/16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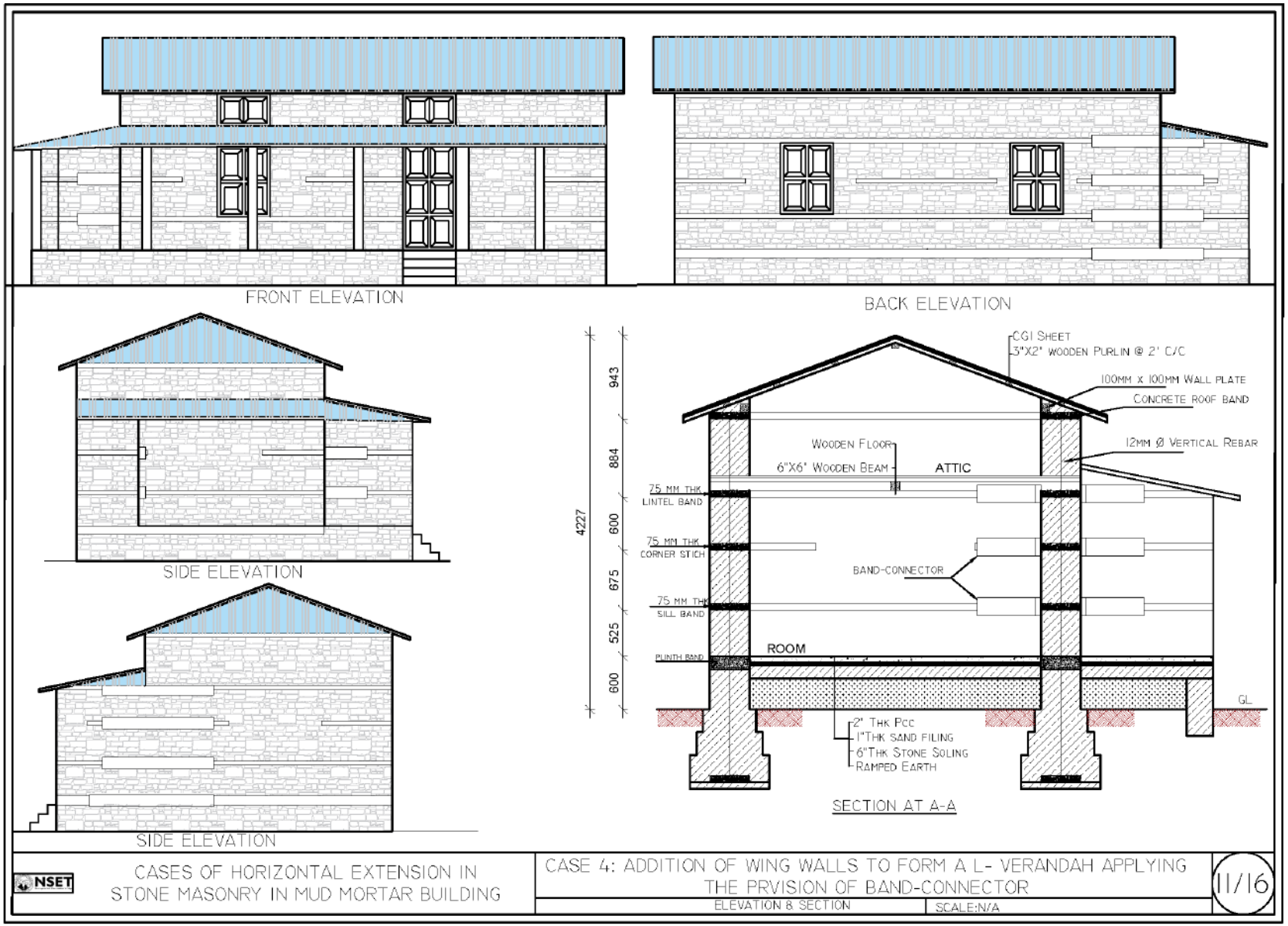
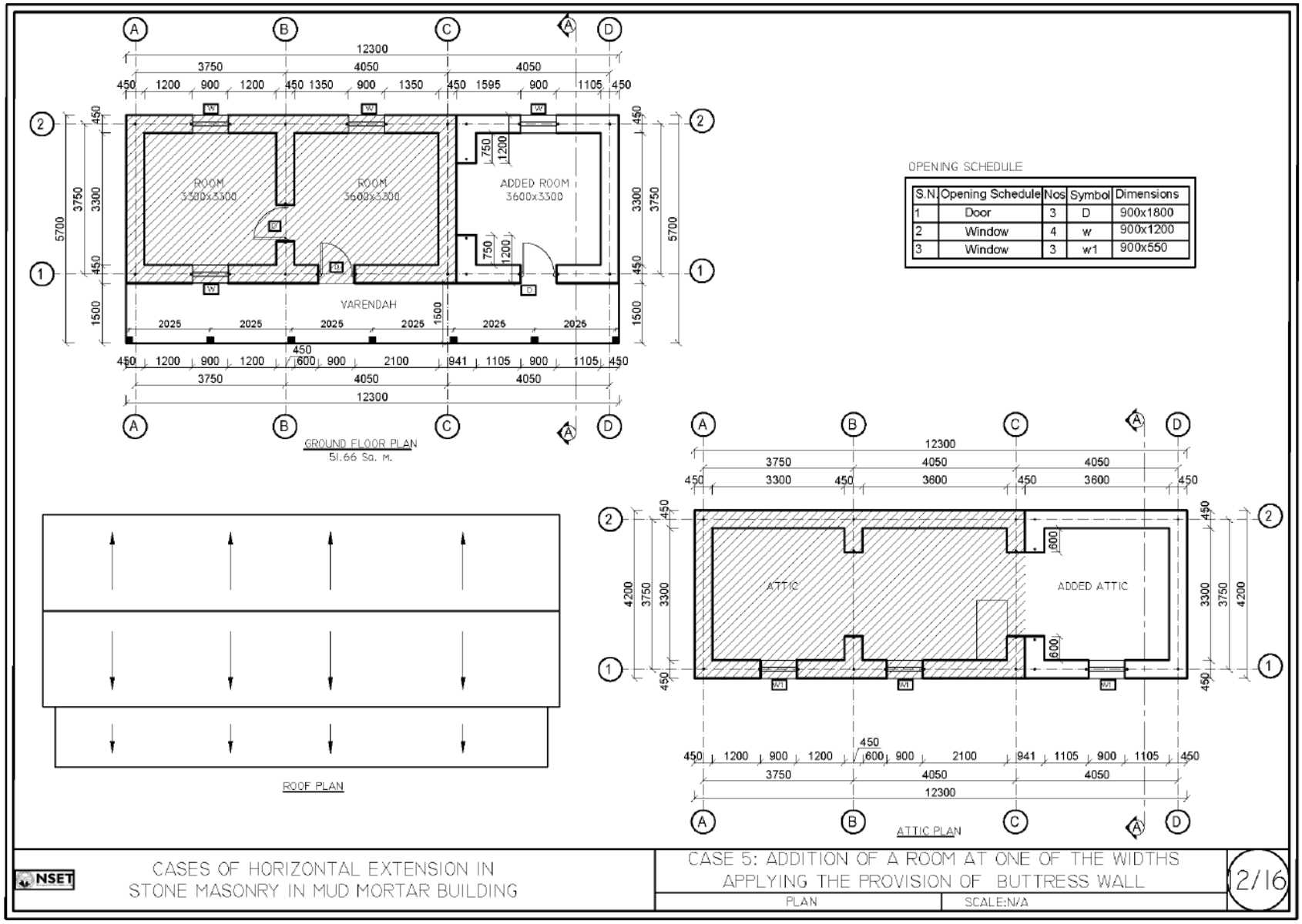
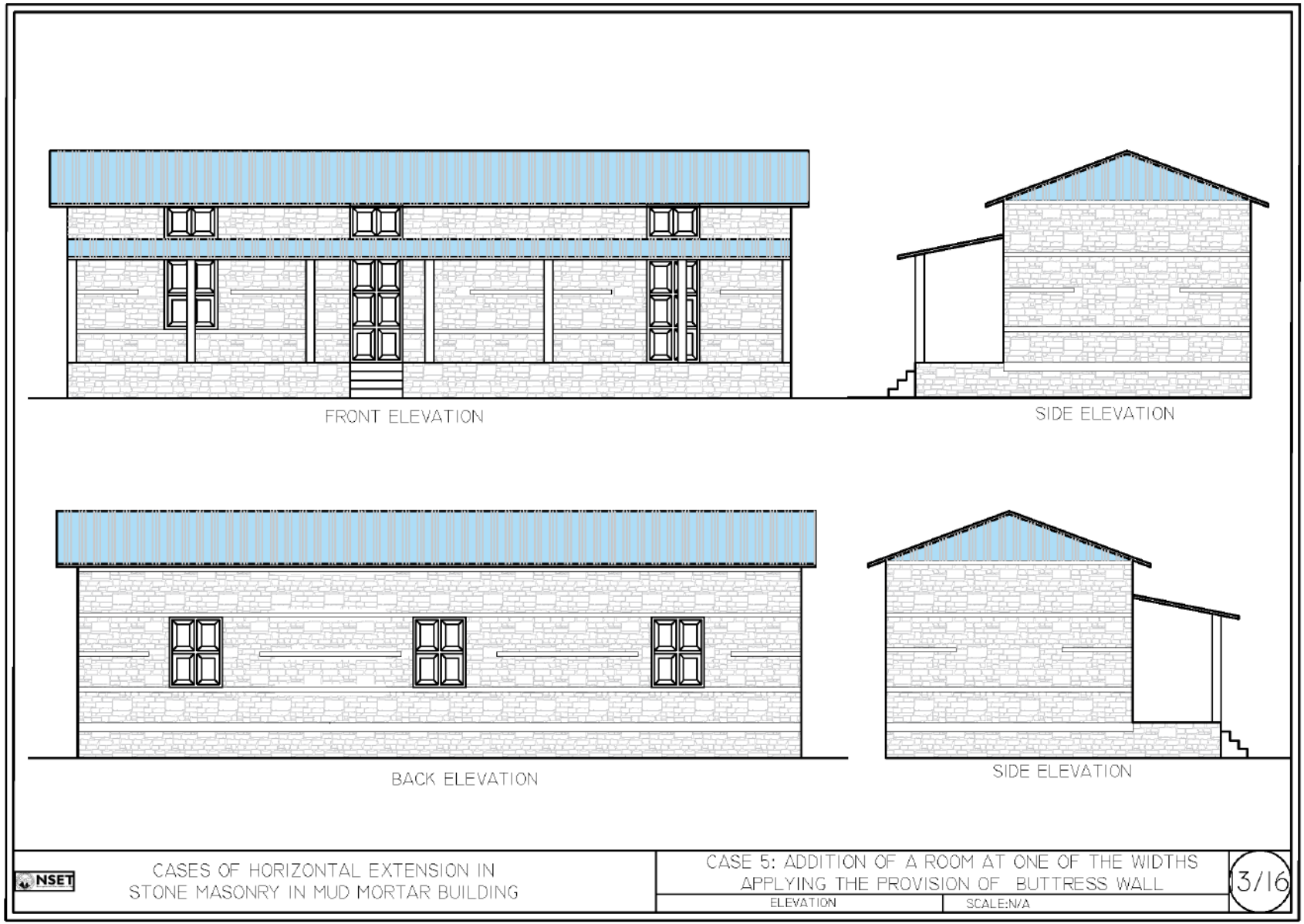
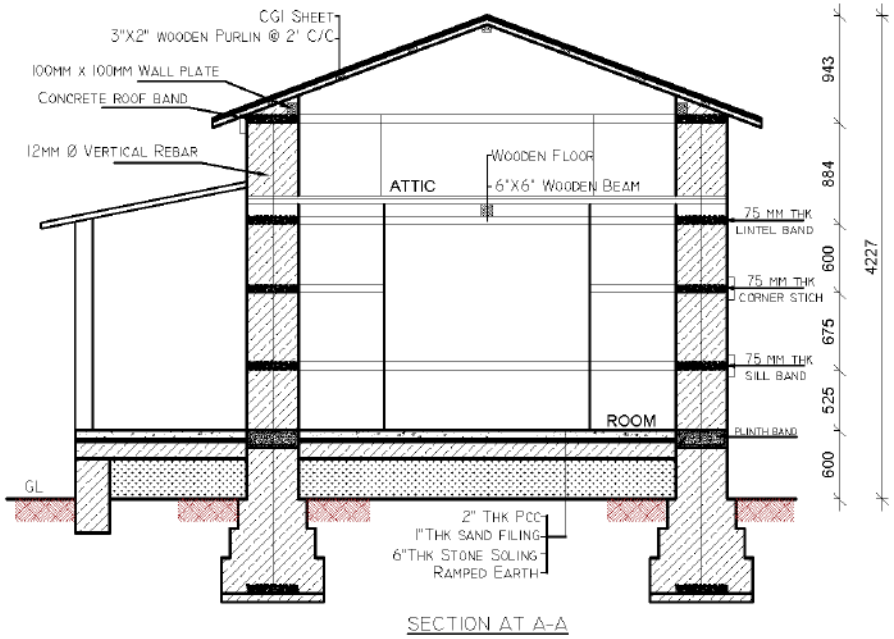
1500
1650
900
1200
450
1350
900
1350
450
ROOM
3580x3300
ROOM
3600x3300
VARENDAH
VARENDAH
4200
3750
2700
1050
600
1500
3300
3750
5700
450
1500
600
1500
450
1200
900
1200
600
900
1050
3750
450
4050
1500
8250
GROUND FLOOR PLAN
34.65 Sq. M.
ROOF PLAN
OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 2 D 900x1800
2 Window 3 w 900x1200
3 Window 2 w1 900x550
8250
3750
4050
3750
450
4050
ATTIC
600
4200
3750
3300
450
1200
900
1200
600
900
2100
ATTIC PLAN
CASES OF HORIZONTAL EXTENSION IN
STONE MASONRY IN MUD MORTAR BUILDING
CASE 4: ADDITION OF WING WALLS TO FORM A L- VERANDAH APPLYING
THE PRVISION OF BAND-CONNECTOR
PLAN
SCALE:N/A
0/16


FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
943
884
600
675
525
600
4227
CGI SHEET
3"X2" WOODEN PURLIN @ 2' C/C
100MM x 100MM WALL PLATE
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
WOODEN FLOOR
6"X6" WOODEN BEAM
ATTIC
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
BAND-CONNECTOR
75 MM THK SILL BAND
PLINTH BAND
ROOM
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
CASE 4: ADDITION OF WING WALLS TO FORM A L- VERANDAH APPLYING THE PRVISION OF BAND-CONNECTOR
ELEVATION & SECTION
SCALE:N/A
11/16


ROOM 3300x3300
ROOM 3600x3300
ADDED ROOM 3600x3300
VARENDAH
GROUND FLOOR PLAN
51.66 Sq. m.
OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 3 D 900x1800
2 Window 4 w 900x1200
3 Window 3 w1 900x550
ROOF PLAN
ATTIC
ADDED ATTIC
ATTIC PLAN
CASES OF HORIZONTAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
CASE 5: ADDITION OF A ROOM AT ONE OF THE WIDTHS APPLYING THE PROVISION OF BUTTRESS WALL
PLAN
SCALE:N/A
2/16


FRONT ELEVATION
SIDE ELEVATION
BACK ELEVATION
SIDE ELEVATION
NSET
CASES OF HORIZONTAL EXTENSION IN
STONE MASONRY IN MUD MORTAR BUILDING
CASE 5: ADDITION OF A ROOM AT ONE OF THE WIDTHS
APPLYING THE PROVISION OF BUTTRESS WALL
ELEVATION
SCALE:N/A
3/16



SECTION AT A-A

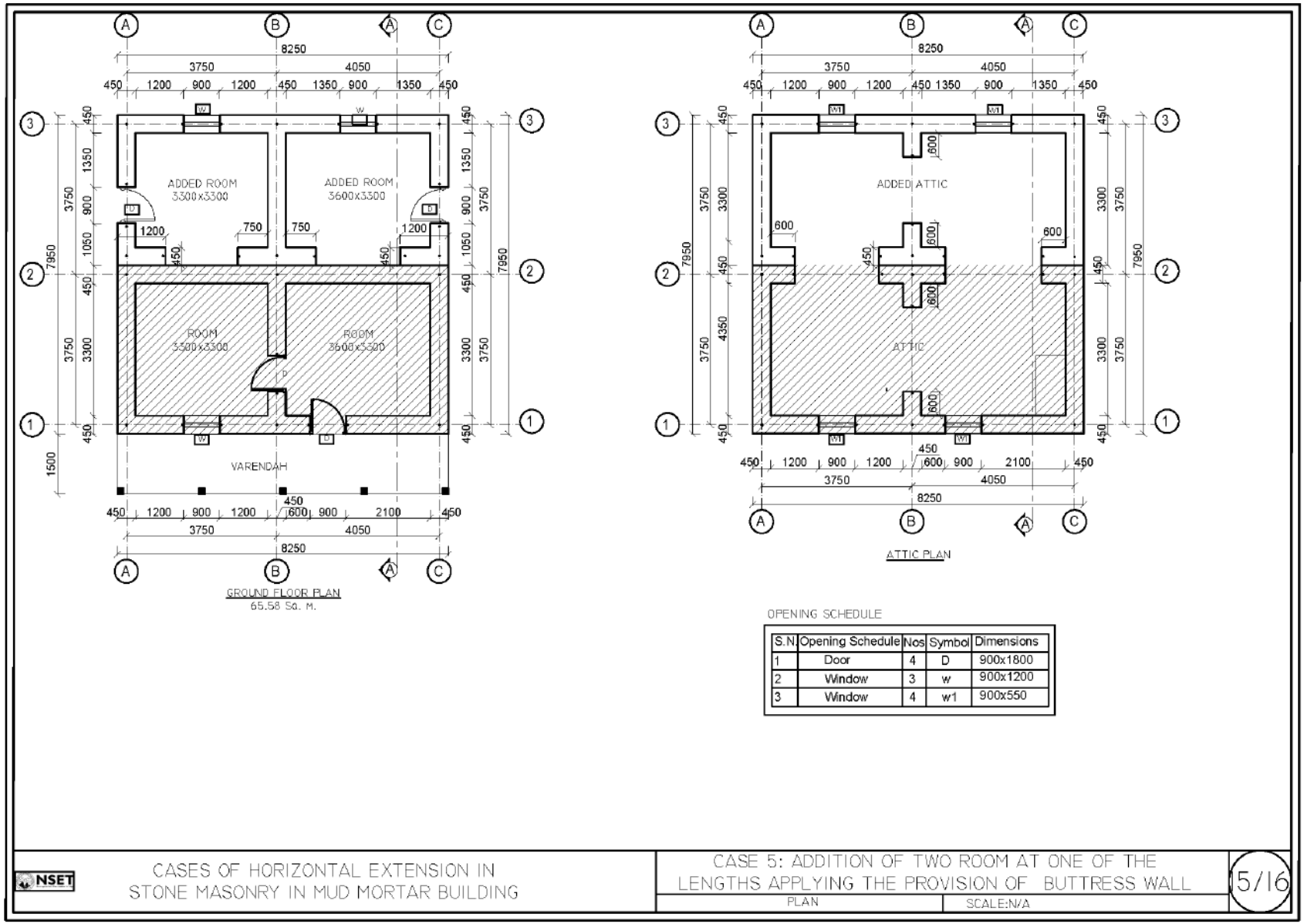
NSET

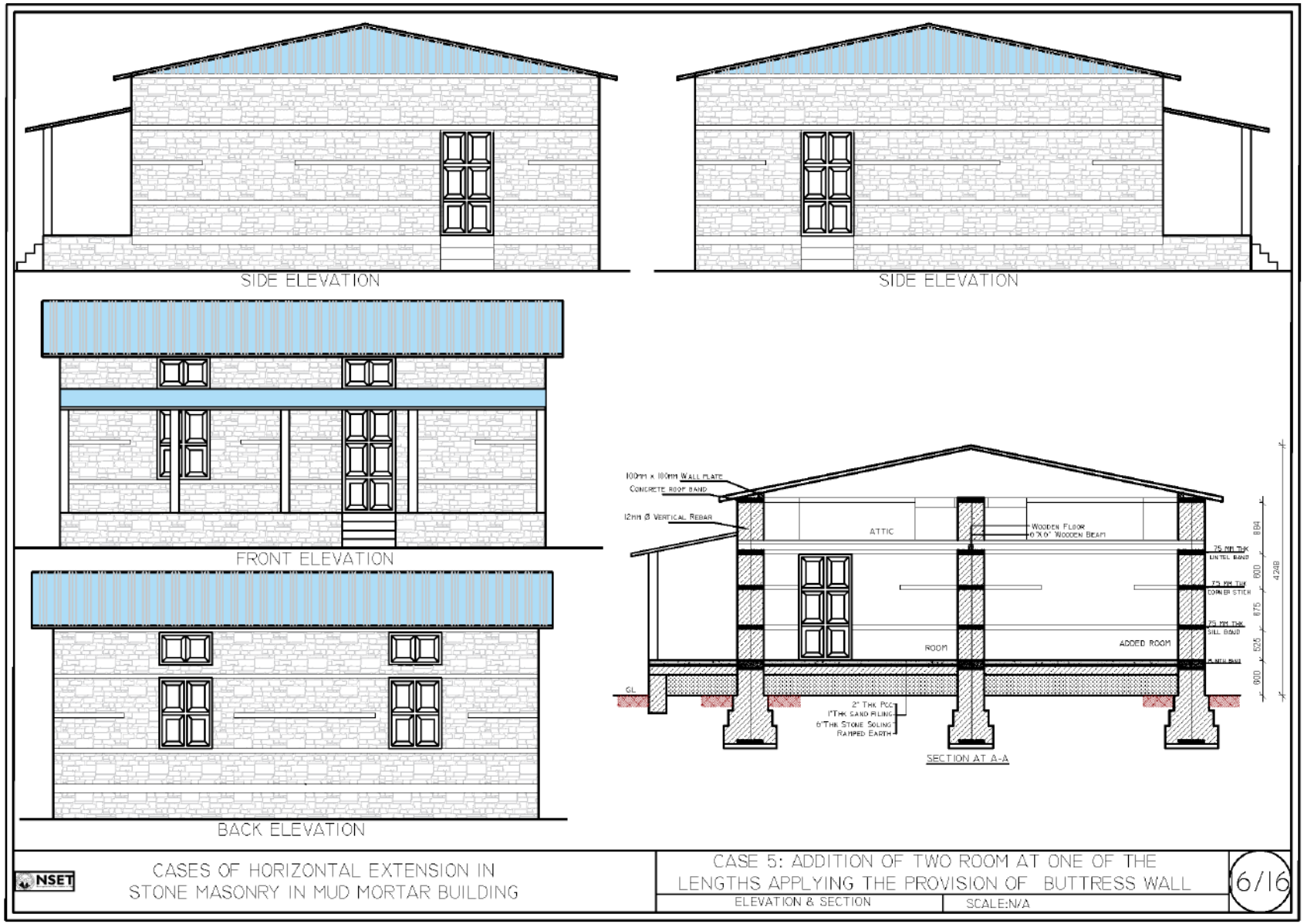
CASES OF HORIZONTAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING

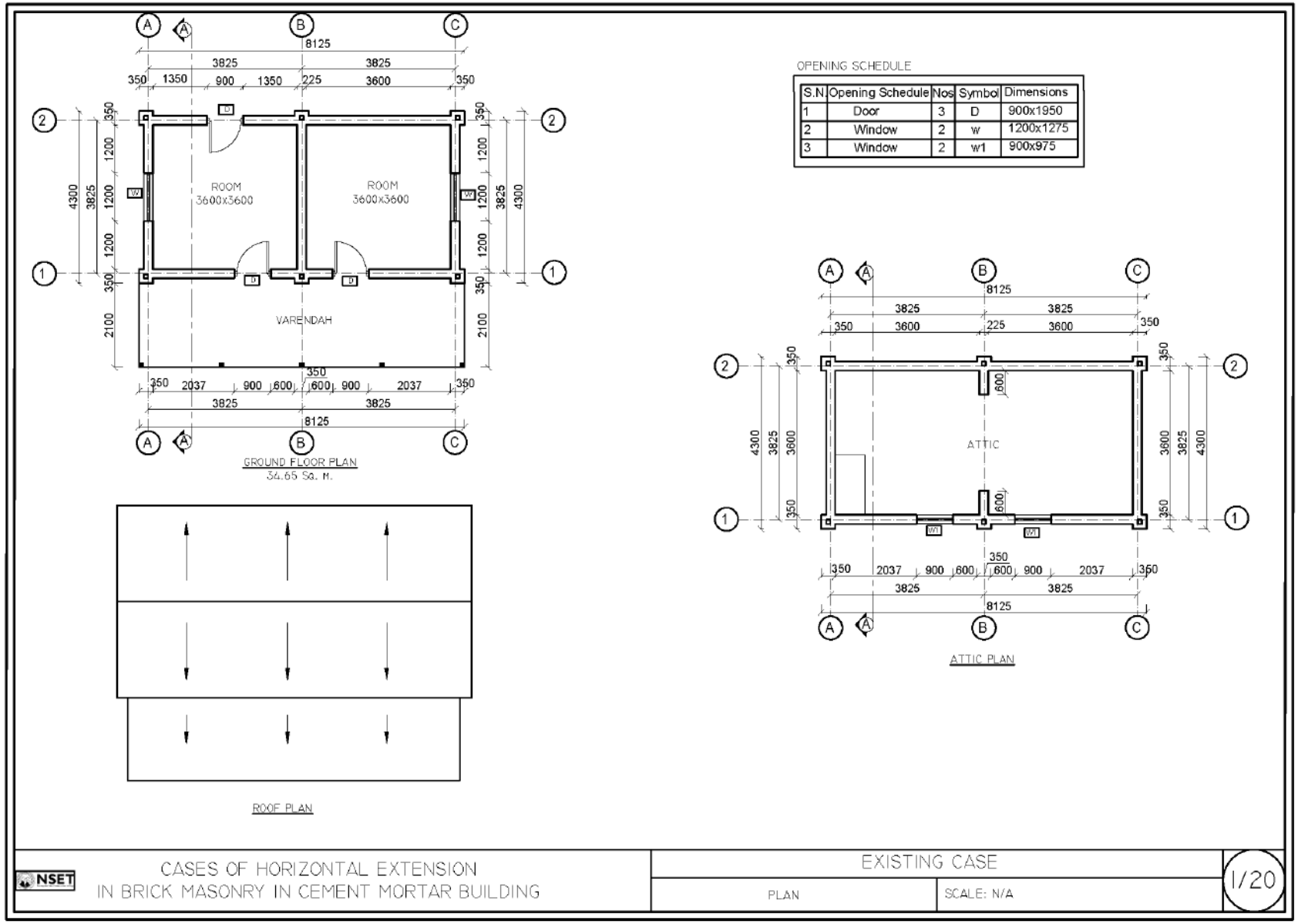
CASE 5: ADDITION OF A ROOM AT ONE OF THE WIDTHS APPLYING THE PROVISION OF BUTTRESS WALL

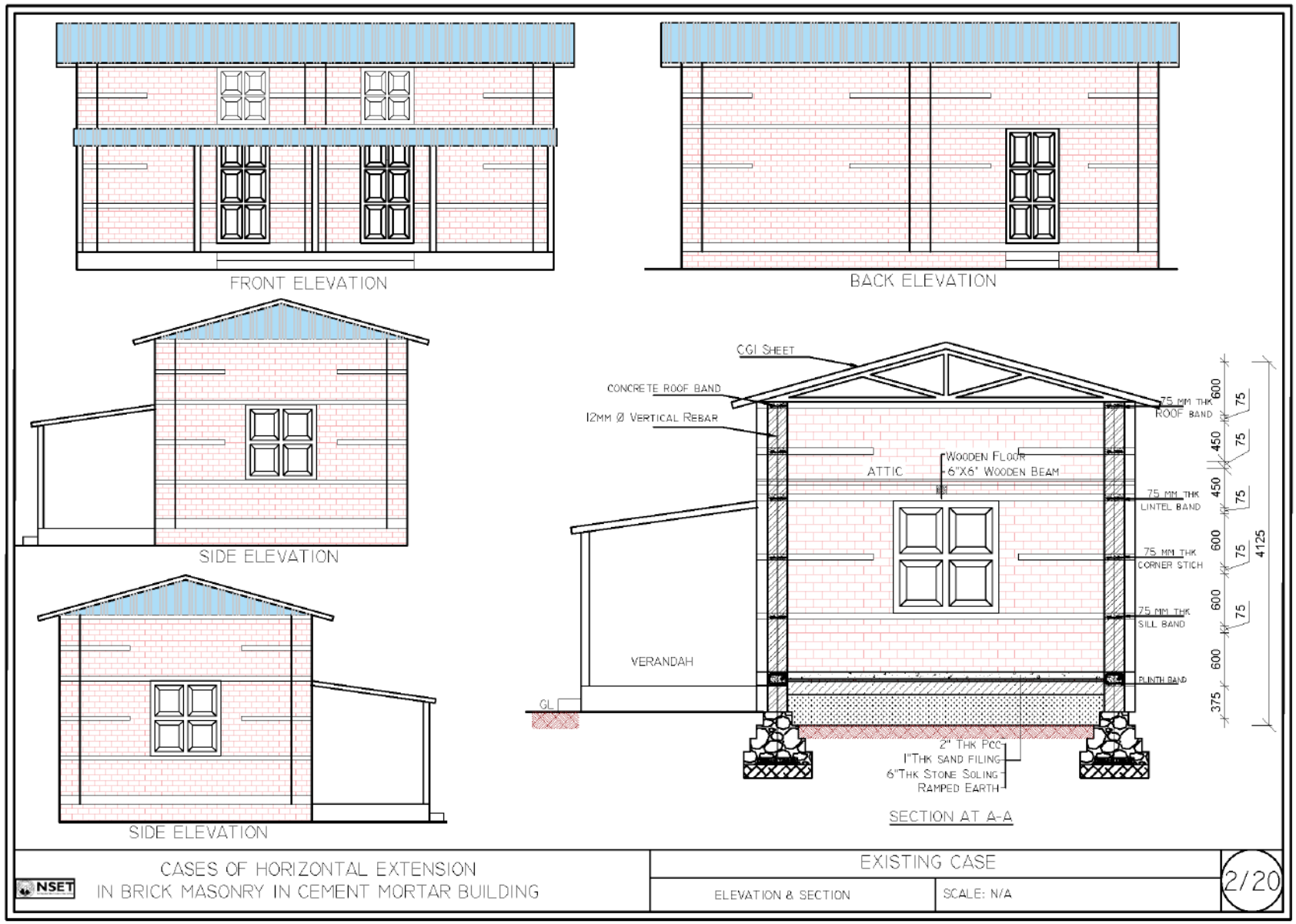
SECTION | SCALE:N/A

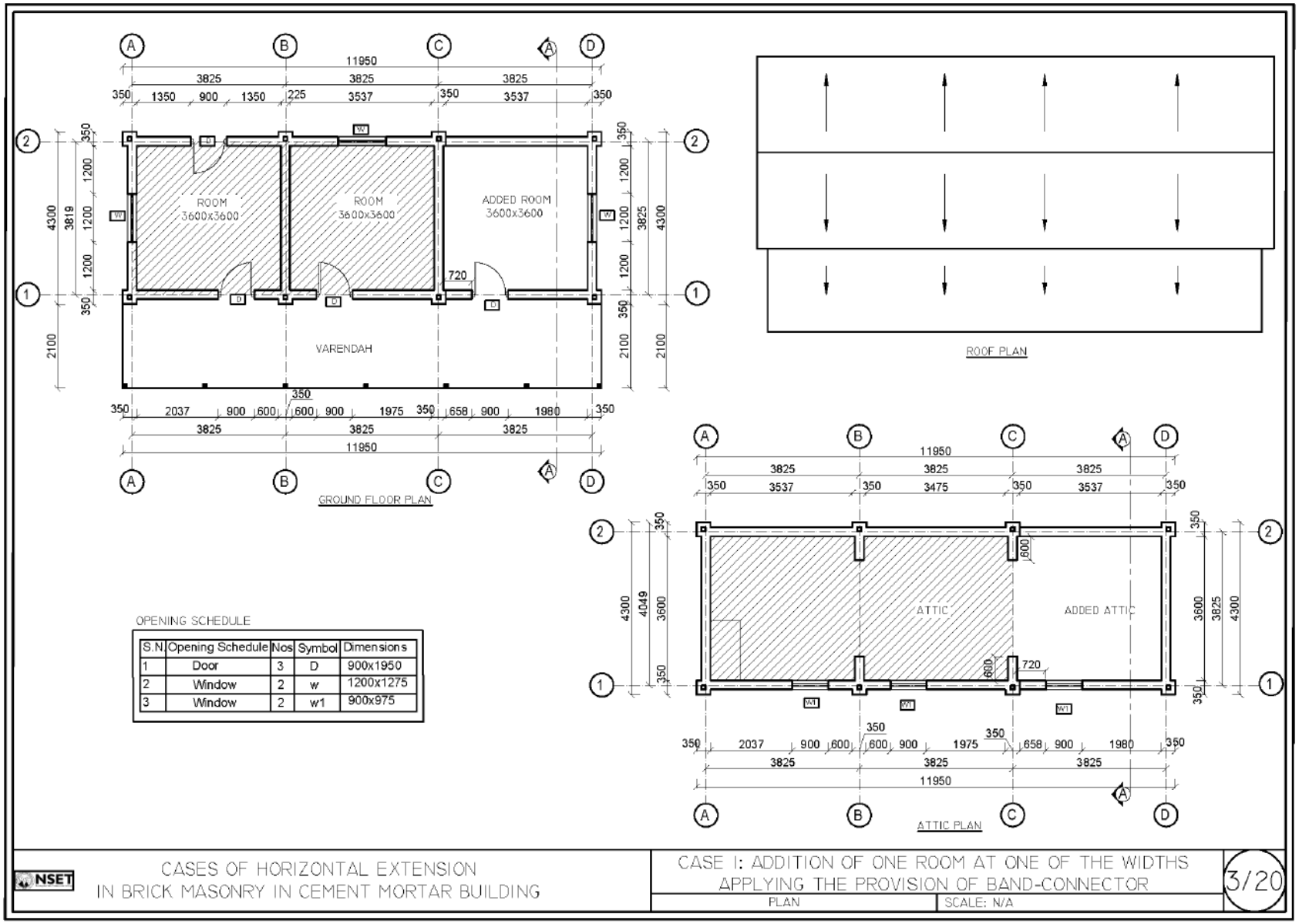
4/16

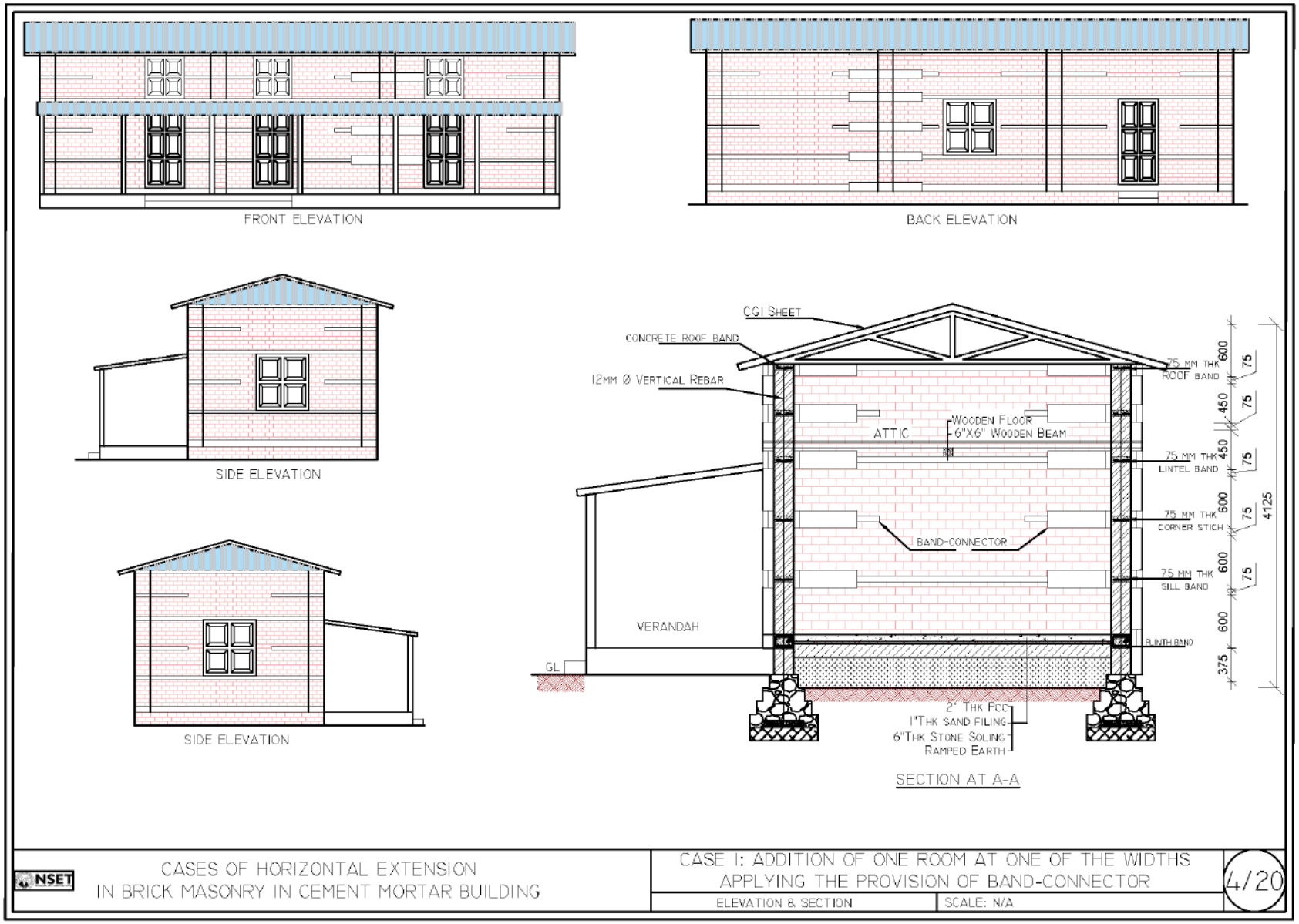

ADDED ROOM 3300x3300
ADDED ROOM 3600x3300
ROOM 3300x3300
ROOM 3600x3300
VARENDAH
GROUND FLOOR PLAN
65.58 Sq. M.
ADDED ATTIC
ATTIC
ATTIC PLAN
OPENING SCHEDULE
S.N. | Opening Schedule | Nos | Symbol | Dimensions
1 | Door | 4 | D | 900x1800
2 | Window | 3 | w | 900x1200
3 | Window | 4 | w1 | 900x550
CASES OF HORIZONTAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
CASE 5: ADDITION OF TWO ROOM AT ONE OF THE LENGTHS APPLYING THE PROVISION OF BUTTRESS WALL
PLAN
SCALE:N/A
5/16

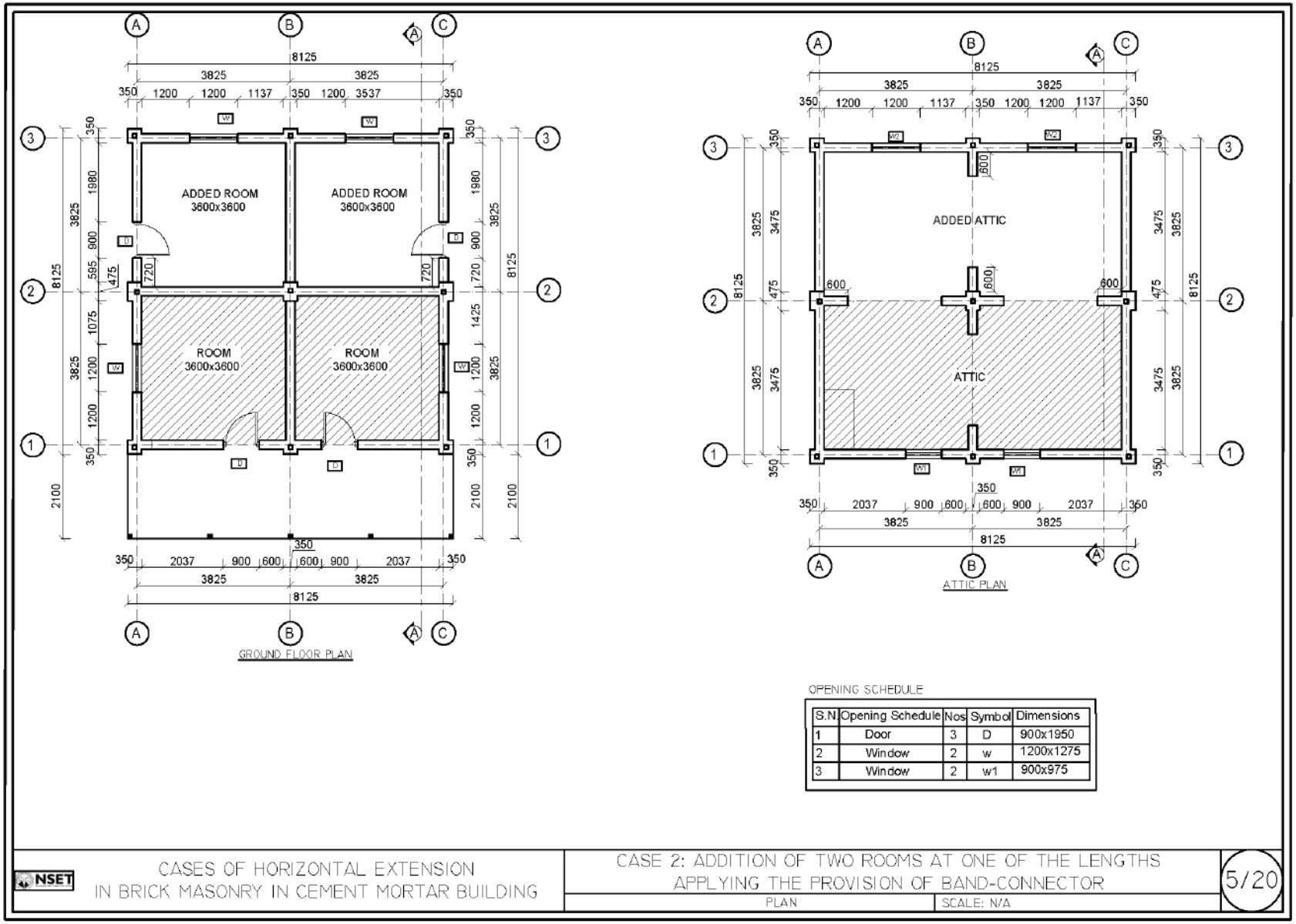

SIDE ELEVATION
SIDE ELEVATION
FRONT ELEVATION
BACK ELEVATION
102mm x 100mm WALL PLATE
CONCRETE ROOF BAND
12mm Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X 6" WOODEN BEAM
75 MM THK
LINTEL BAND
75 MM THK
CORNER STICH
75 MM THK
SILL BAND
ROOM
ADDED ROOM
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
SECTION AT A-A
894
600
4248
675
525
600
NSET
CASES OF HORIZONTAL EXTENSION IN
STONE MASONRY IN MUD MORTAR BUILDING
CASE 5: ADDITION OF TWO ROOM AT ONE OF THE
LENGTHS APPLYING THE PROVISION OF BUTTRESS WALL
ELEVATION & SECTION
SCALE:N/A
6/16

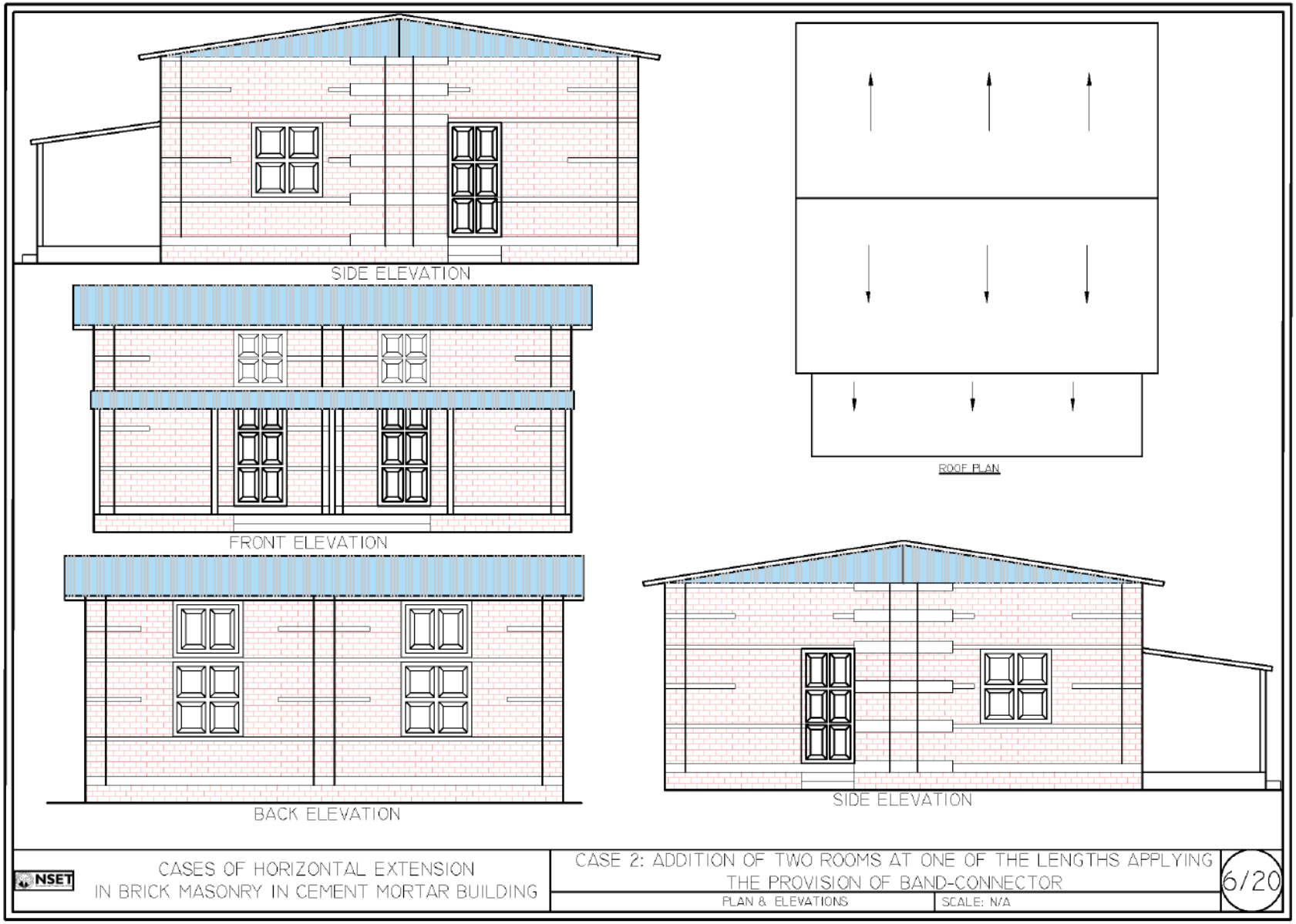

OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 3 D 900x1950
2 Window 2 w 1200x1275
3 Window 2 w1 900x975
ROOM 3600x3600
ROOM 3600x3600
VARENDAH
GROUND FLOOR PLAN
34.65 Sq. M.
ROOF PLAN
ATTIC
ATTIC PLAN
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
EXISTING CASE
PLAN
SCALE: N/A
1/20

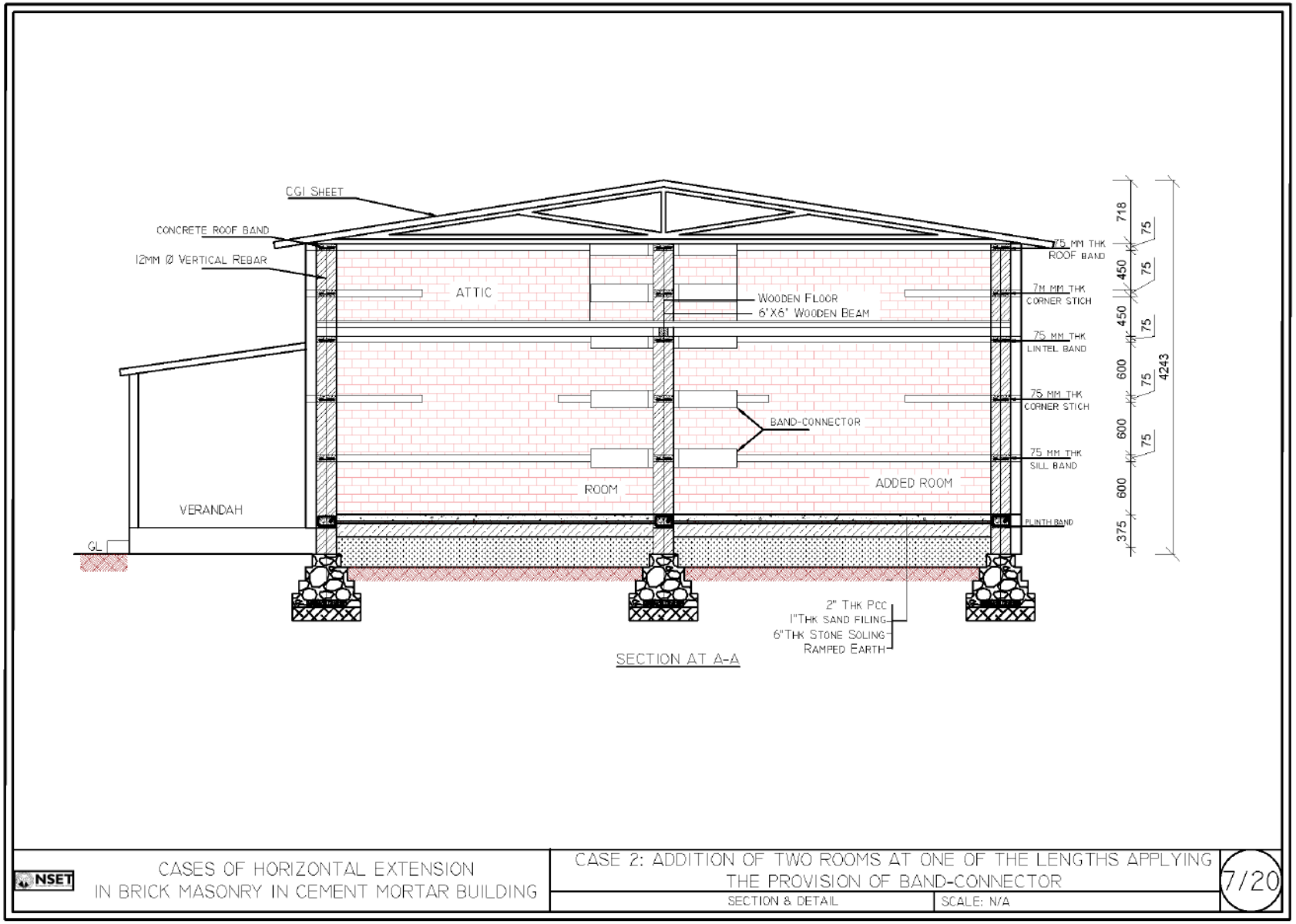

FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK ROOF BAND
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
PLINTH BAND
VERANDAH
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
600
75
450
75
450
75
600
75
600
75
600
375
4125
SECTION AT A-A
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
NSET
EXISTING CASE
ELEVATION & SECTION
SCALE: N/A
2/20

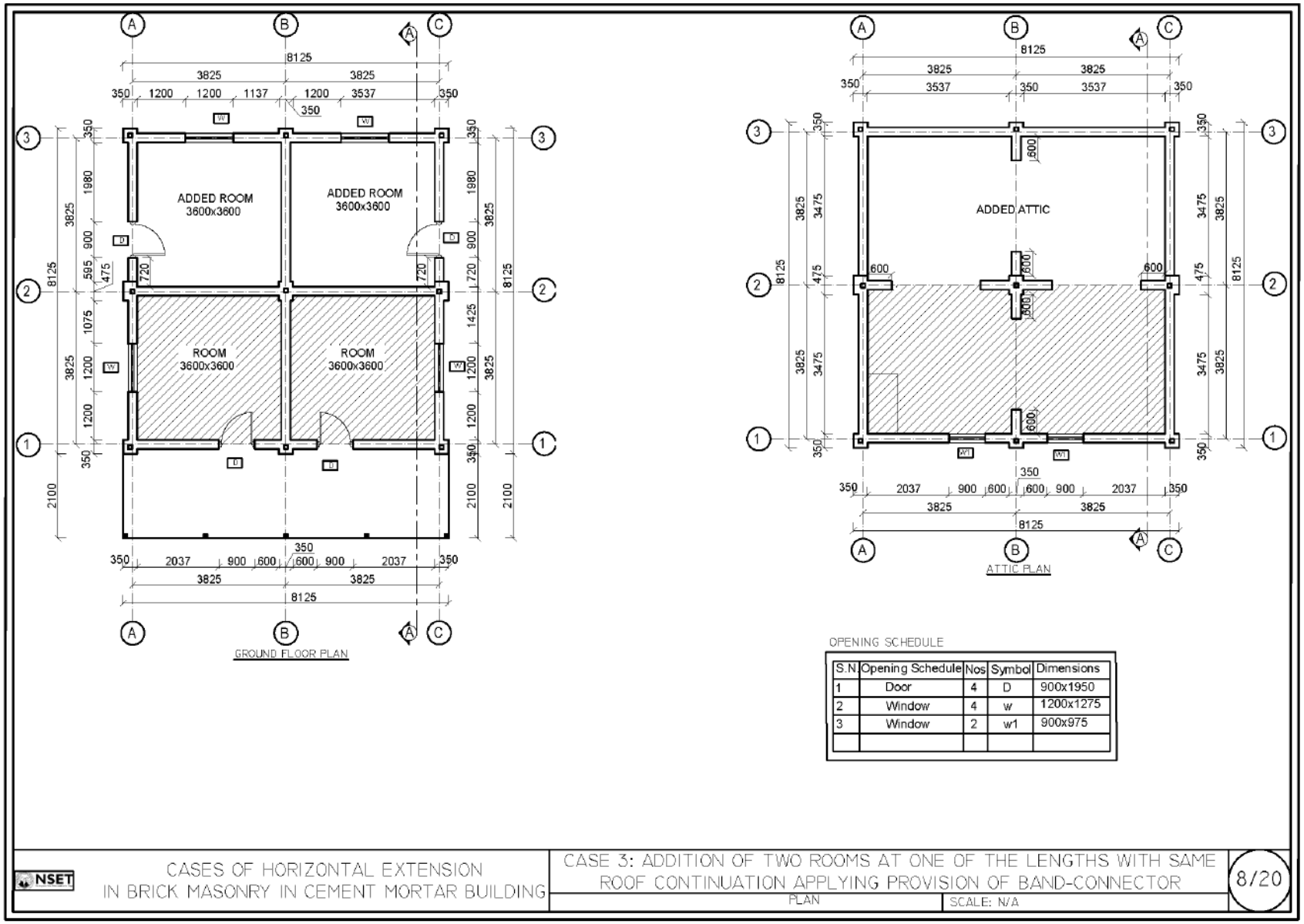

ROOM 3600x3600
ROOM 3600x3600
ADDED ROOM 3600x3600
VARENDAH
GROUND FLOOR PLAN
ROOF PLAN
ATTIC
ADDED ATTIC
ATTIC PLAN
OPENING SCHEDULE
S.N. Opening Schedule Nos. Symbol Dimensions
1 Door 3 D 900x1950
2 Window 2 w 1200x1275
3 Window 2 w1 900x975
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE I: ADDITION OF ONE ROOM AT ONE OF THE WIDTHS
APPLYING THE PROVISION OF BAND-CONNECTOR
PLAN
SCALE: N/A
3/20

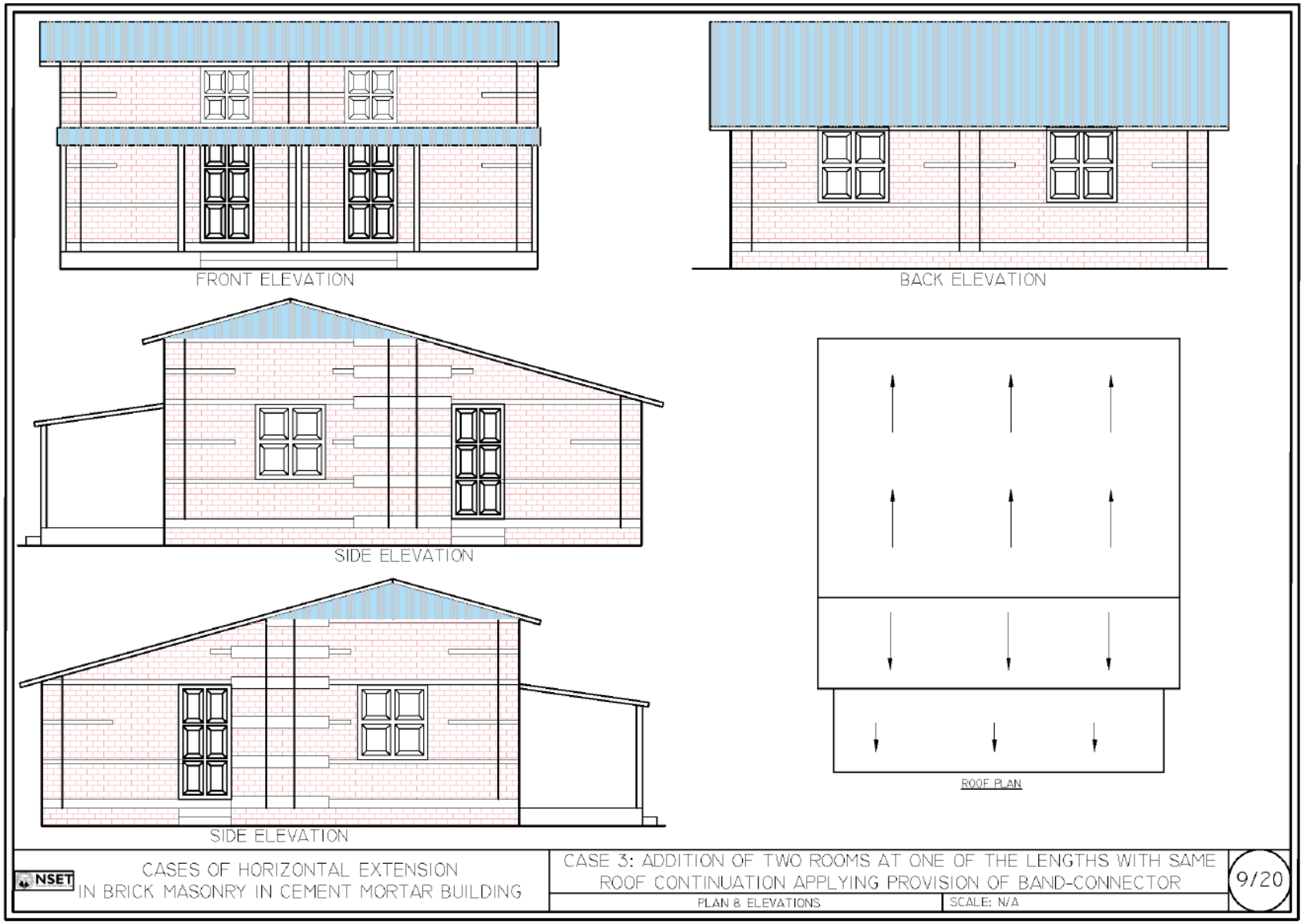

FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK ROOF BAND
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
PLINTH BAND
BAND-CONNECTOR
VERANDAH
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
600
75
450
4125
375
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE I: ADDITION OF ONE ROOM AT ONE OF THE WIDTHS
APPLYING THE PROVISION OF BAND-CONNECTOR
ELEVATION & SECTION
SCALE: N/A
4/20

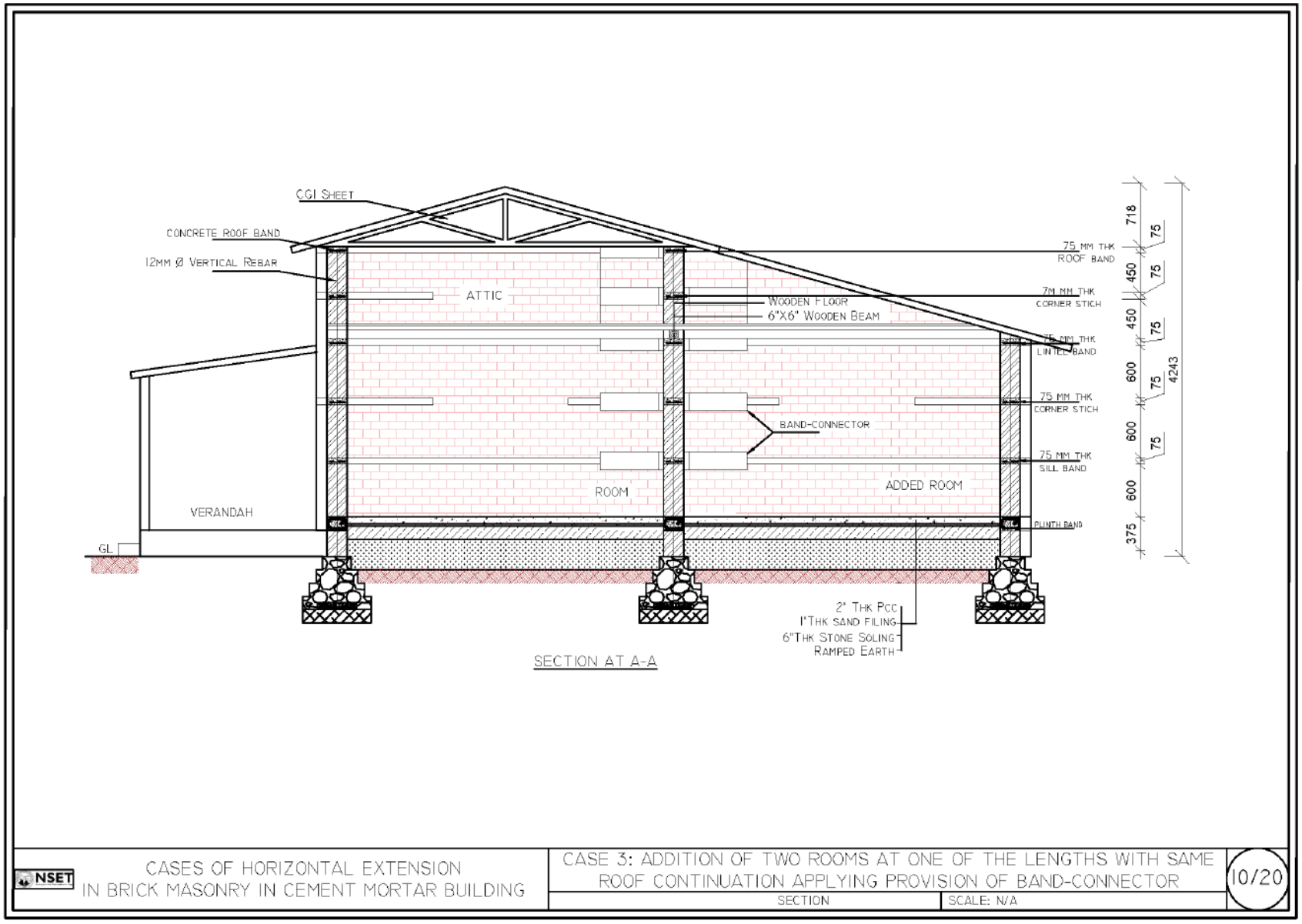

ADDED ROOM
3600x3600
ADDED ROOM
3600x3600
ROOM
3600x3600
ROOM
3600x3600
GROUND FLOOR PLAN
ADDED ATTIC
ATTIC
ATTIC PLAN
OPENING SCHEDULE
S.N Opening Schedule Nos Symbol Dimensions
1 Door 3 D 900x1950
2 Window 2 w 1200x1275
3 Window 2 w1 900x975
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 2: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS
APPLYING THE PROVISION OF BAND-CONNECTOR
PLAN
SCALE: N/A
5/20

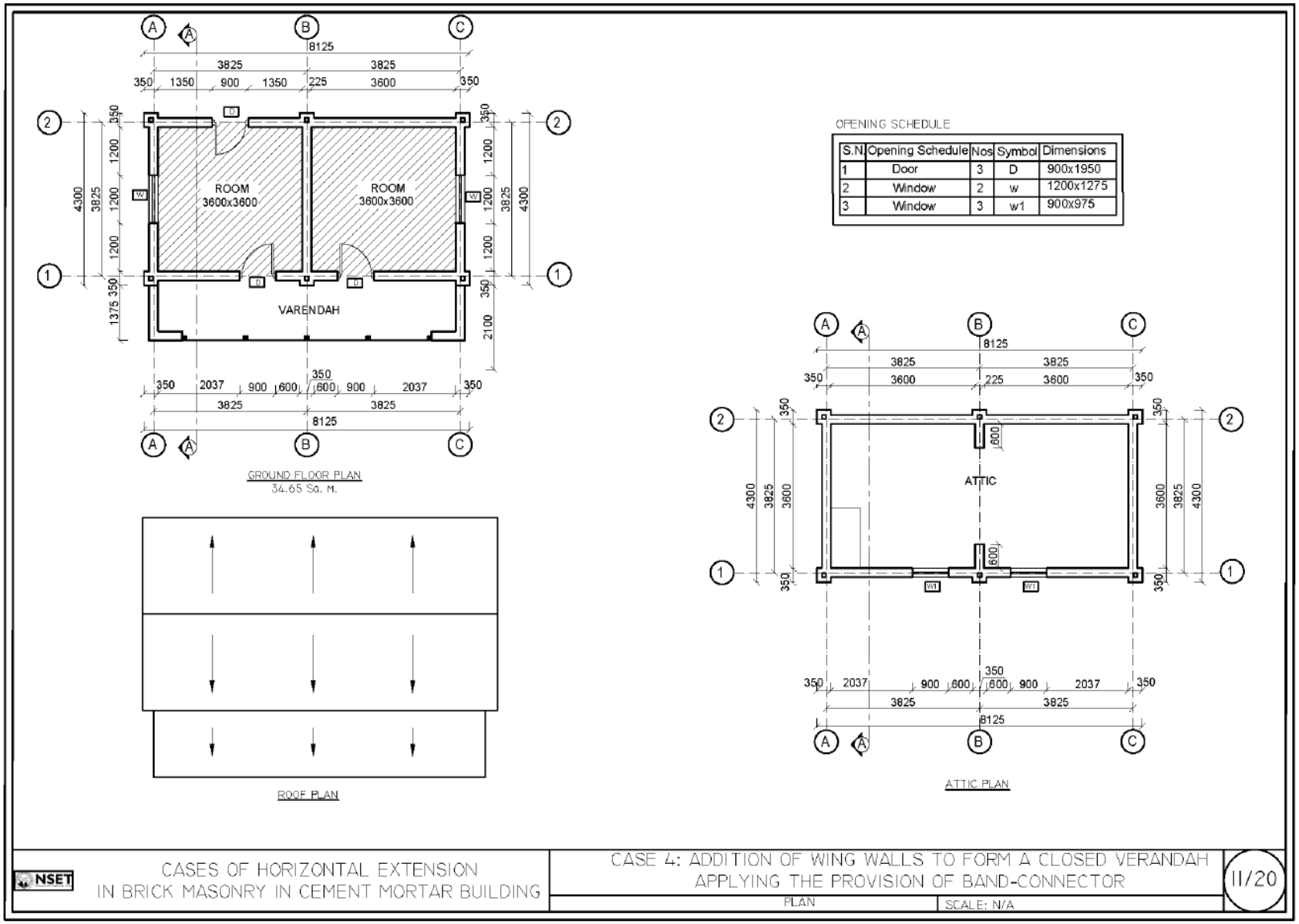

SIDE ELEVATION
ROOF PLAN
FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 2: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS APPLYING
THE PROVISION OF BAND-CONNECTOR
PLAN & ELEVATIONS
SCALE: N/A
6/20

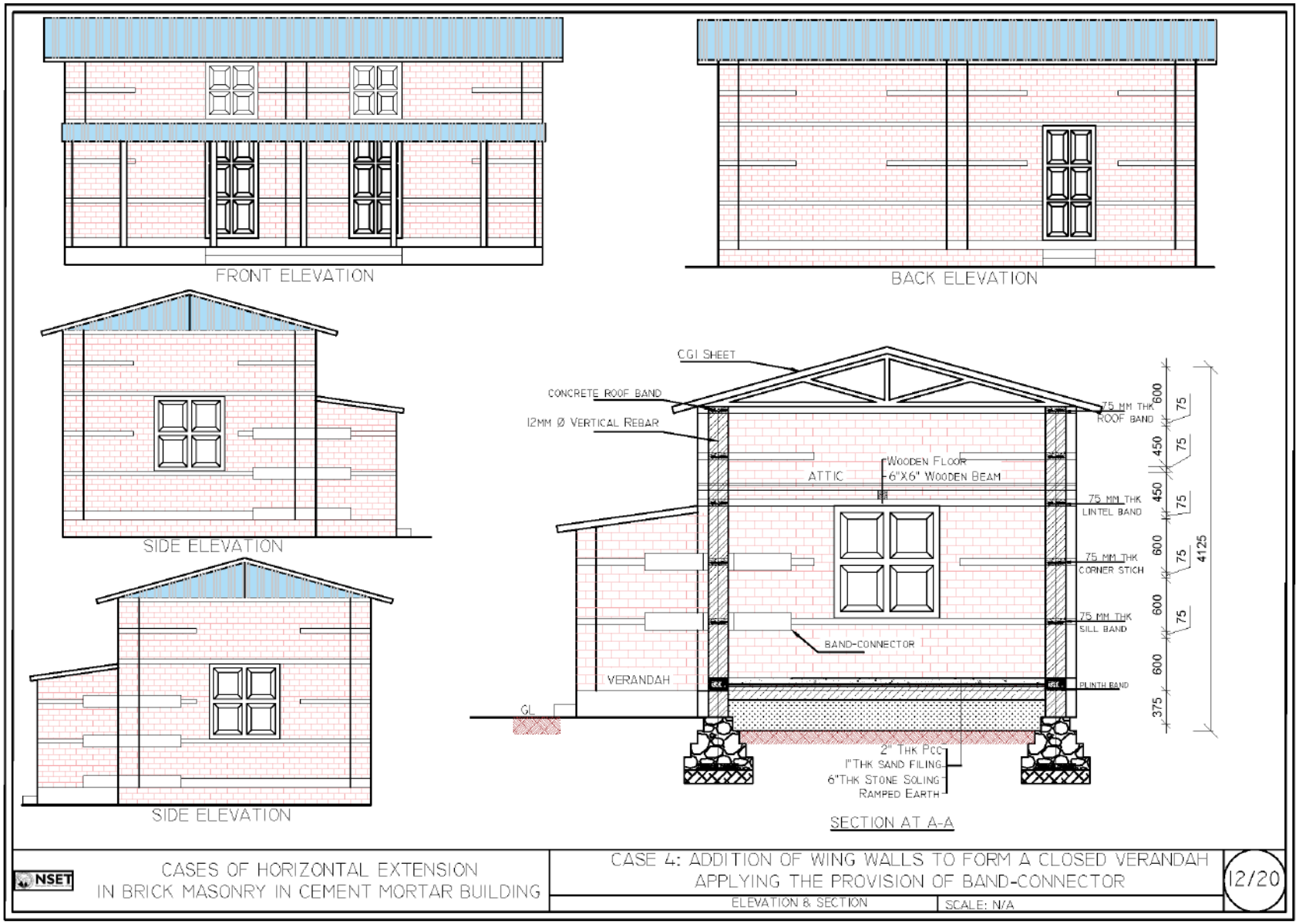

CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
BAND-CONNECTOR
ROOM
ADDED ROOM
VERANDAH
GL
75 MM THK ROOF BAND
7M MM THK CORNER STICH
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
PLINTH BAND
718
75
450
75
450
75
600
75
600
75
600
375
4243
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 2: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS APPLYING THE PROVISION OF BAND-CONNECTOR
SECTION & DETAIL
SCALE: N/A
7/20

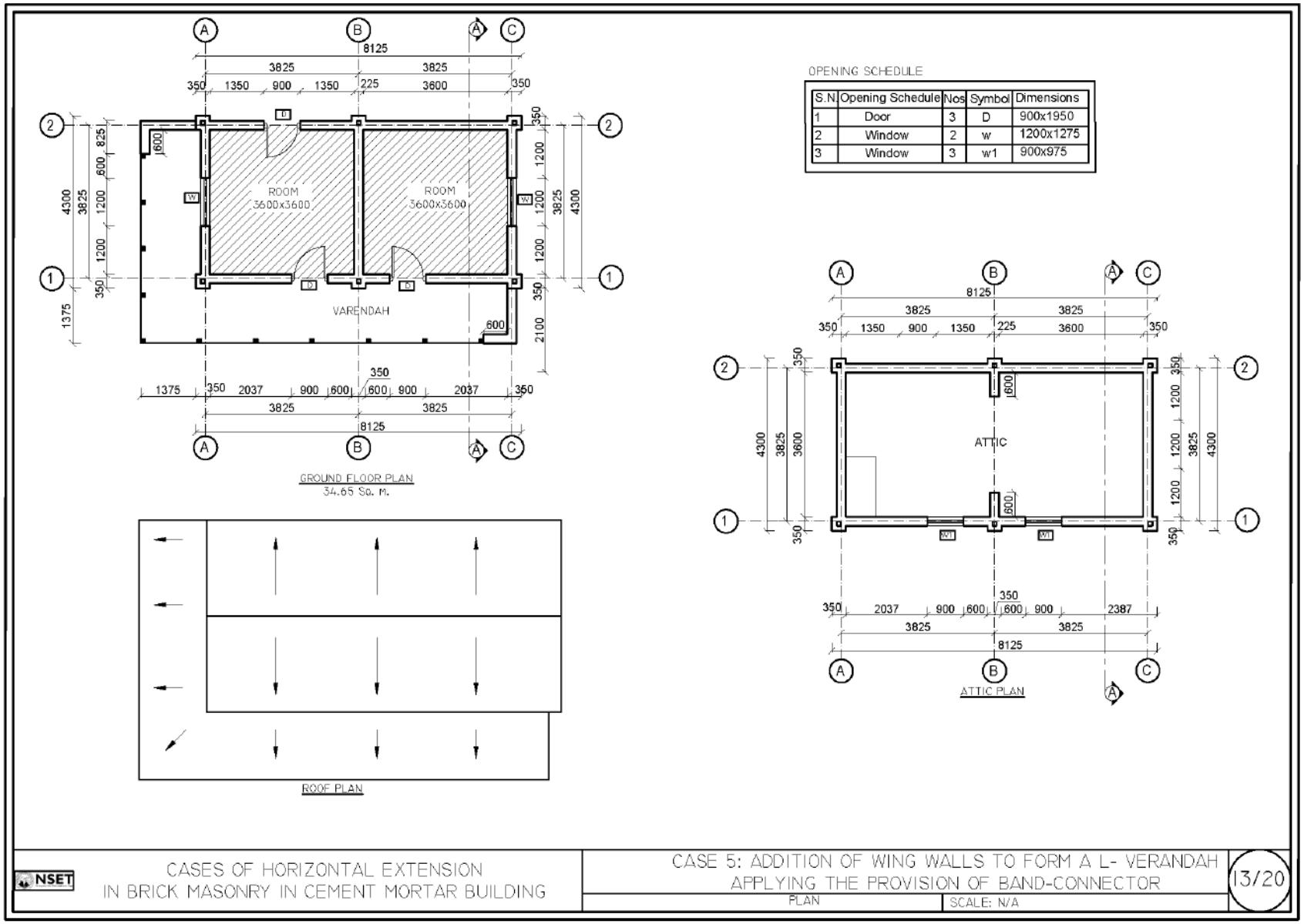

ADDED ROOM
3600x3600
ADDED ROOM
3600x3600
ROOM
3600x3600
ROOM
3600x3600
GROUND FLOOR PLAN
ADDED ATTIC
ATTIC PLAN
OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 4 D 900x1950
2 Window 4 w 1200x1275
3 Window 2 w1 900x975
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 3: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS WITH SAME ROOF CONTINUATION APPLYING PROVISION OF BAND-CONNECTOR
PLAN
SCALE: N/A
8/20

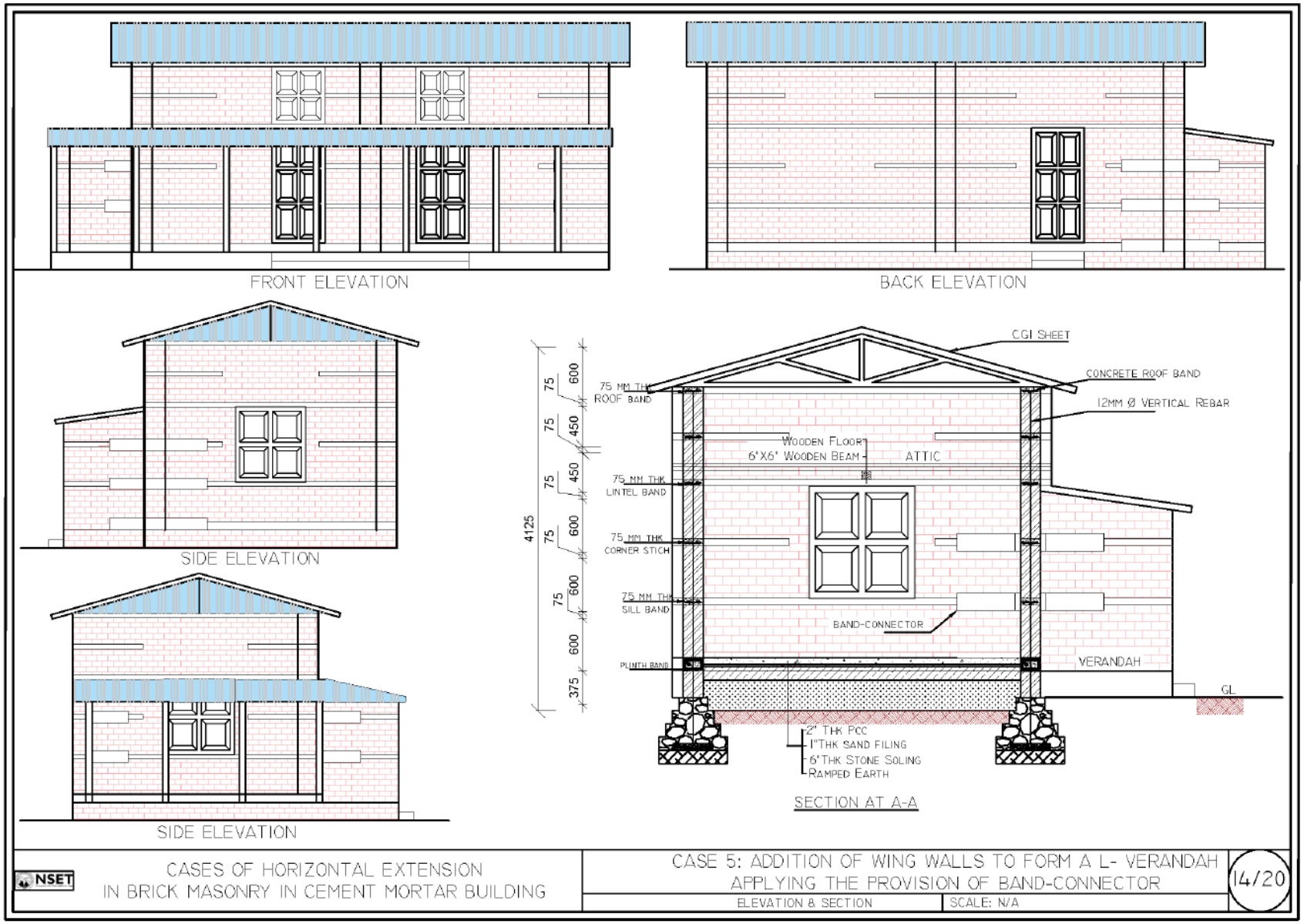

FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
ROOF PLAN
SIDE ELEVATION
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 3: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS WITH SAME ROOF CONTINUATION APPLYING PROVISION OF BAND-CONNECTOR
PLAN & ELEVATIONS
SCALE: N/A
9/20

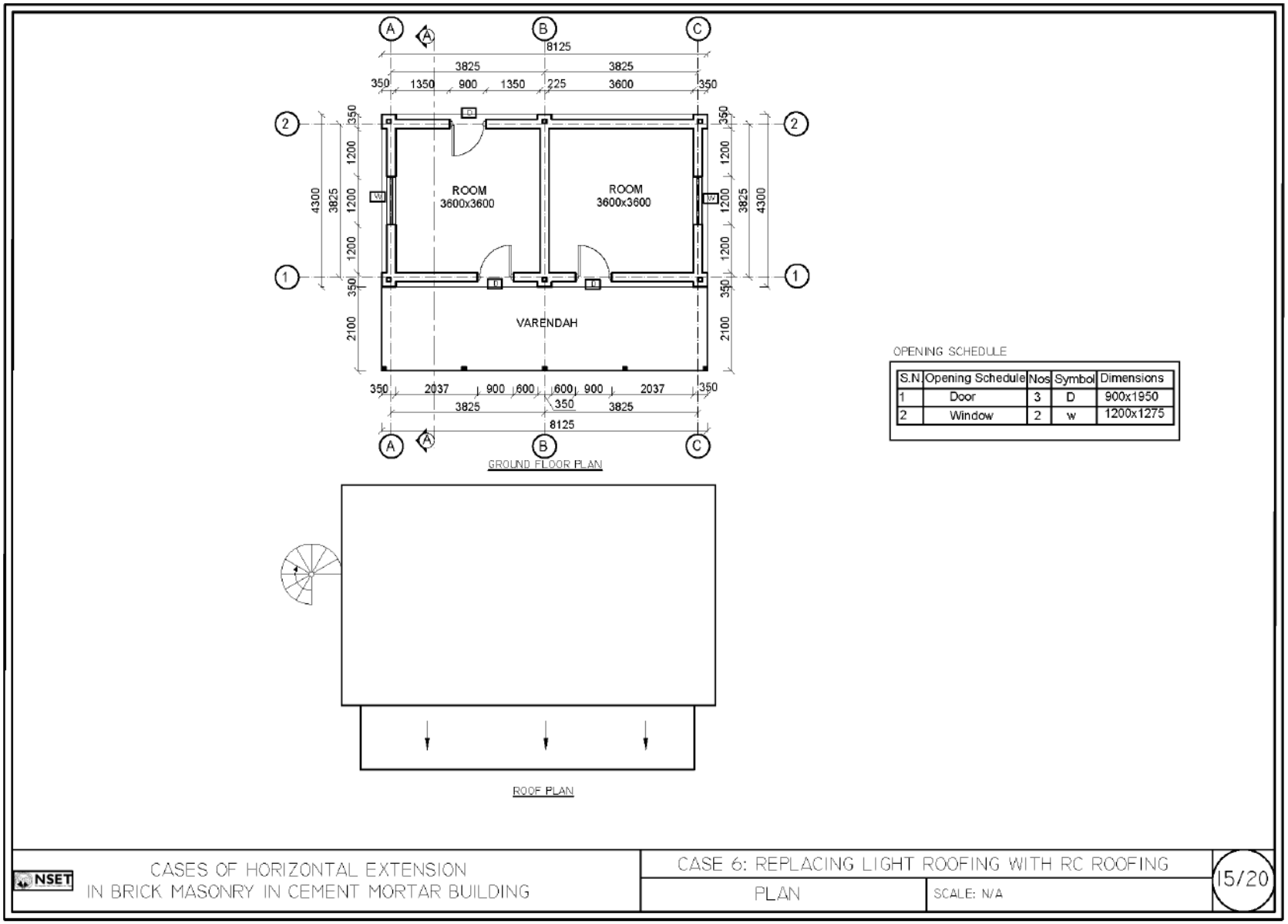

CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK ROOF BAND
75 MM THK CORNER STICH
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
BAND-CONNECTOR
75 MM THK SILL BAND
ROOM
ADDED ROOM
VERANDAH
GL
PLINTH BAND
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
718
75
450
75
450
75
600
75
4243
600
75
600
375
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 3: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS WITH SAME ROOF CONTINUATION APPLYING PROVISION OF BAND-CONNECTOR
SECTION
SCALE: N/A
10/20

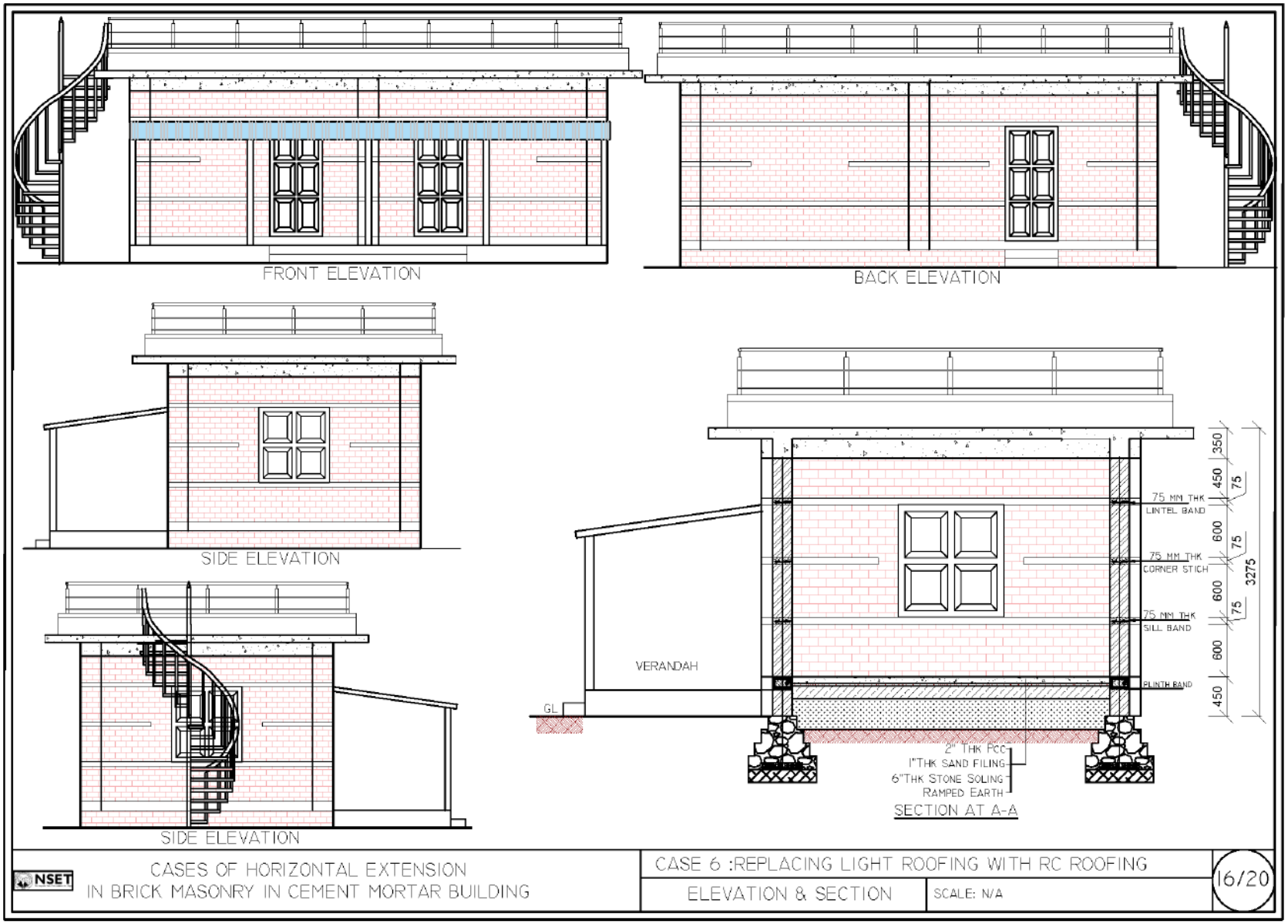

ROOM
3600x3600
ROOM
3600x3600
VARENDAH
GROUND FLOOR PLAN
34.65 Sq. M.
ROOF PLAN
OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 3 D 900x1950
2 Window 2 w 1200x1275
3 Window 3 w1 900x975
ATTIC
ATTIC PLAN
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 4: ADDITION OF WING WALLS TO FORM A CLOSED VERANDAH
APPLYING THE PROVISION OF BAND-CONNECTOR
PLAN
SCALE: N/A
11/20

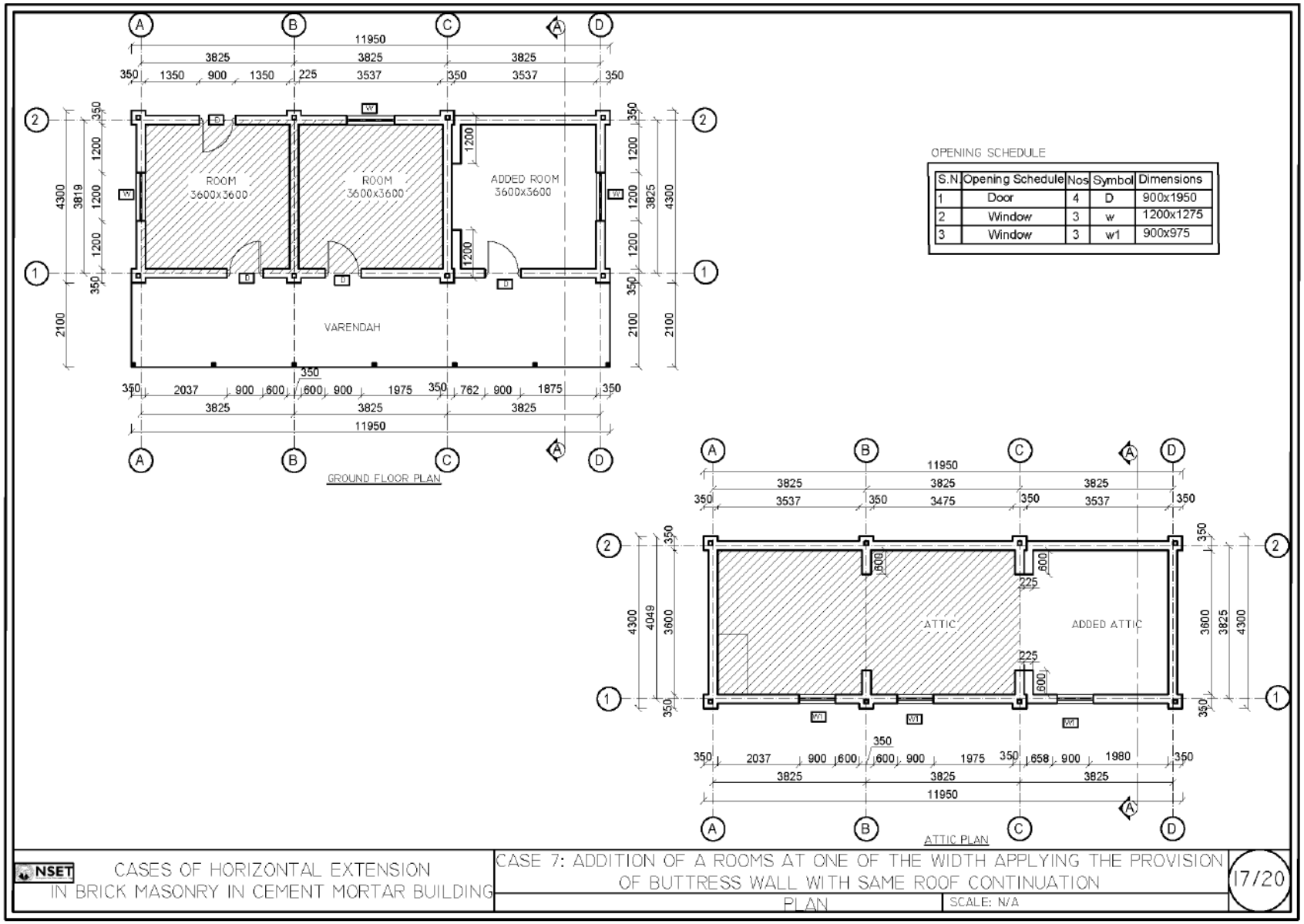

FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK ROOF BAND
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
BAND-CONNECTOR
VERANDAH
PLINTH BAND
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
600
75
450
4125
375
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 4: ADDITION OF WING WALLS TO FORM A CLOSED VERANDAH
APPLYING THE PROVISION OF BAND-CONNECTOR
ELEVATION & SECTION
SCALE: N/A
12/20

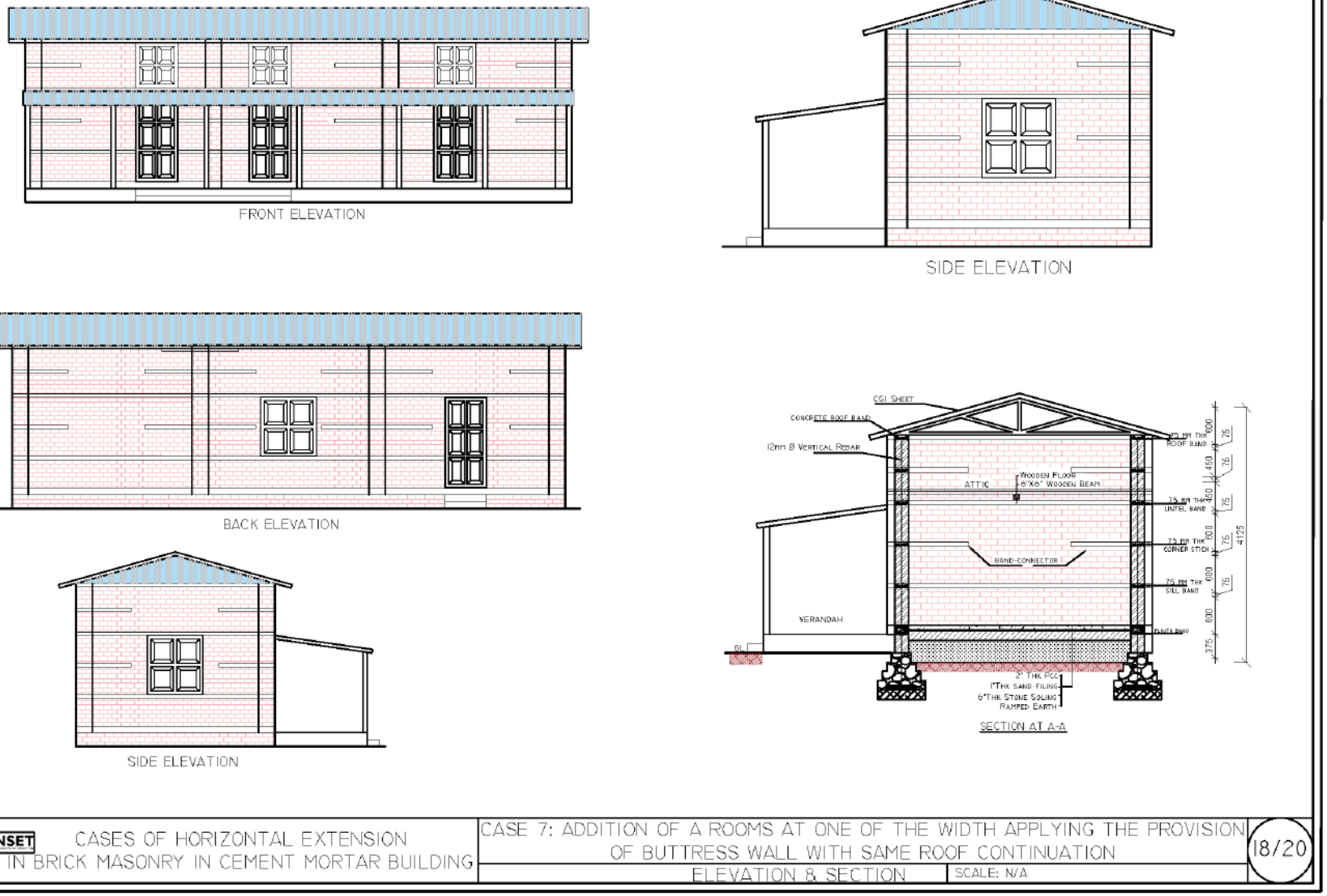

OPENING SCHEDULE
S.N | Opening Schedule | Nos | Symbol | Dimensions
1 | Door | 3 | D | 900x1950
2 | Window | 2 | w | 1200x1275
3 | Window | 3 | w1 | 900x975
ROOM 3600x3600
ROOM 3600x3600
VARENDAH
GROUND FLOOR PLAN
34.65 Sq. M.
ROOF PLAN
ATTIC
ATTIC PLAN
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 5: ADDITION OF WING WALLS TO FORM A L- VERANDAH
APPLYING THE PROVISION OF BAND-CONNECTOR
PLAN
SCALE: N/A
13/20

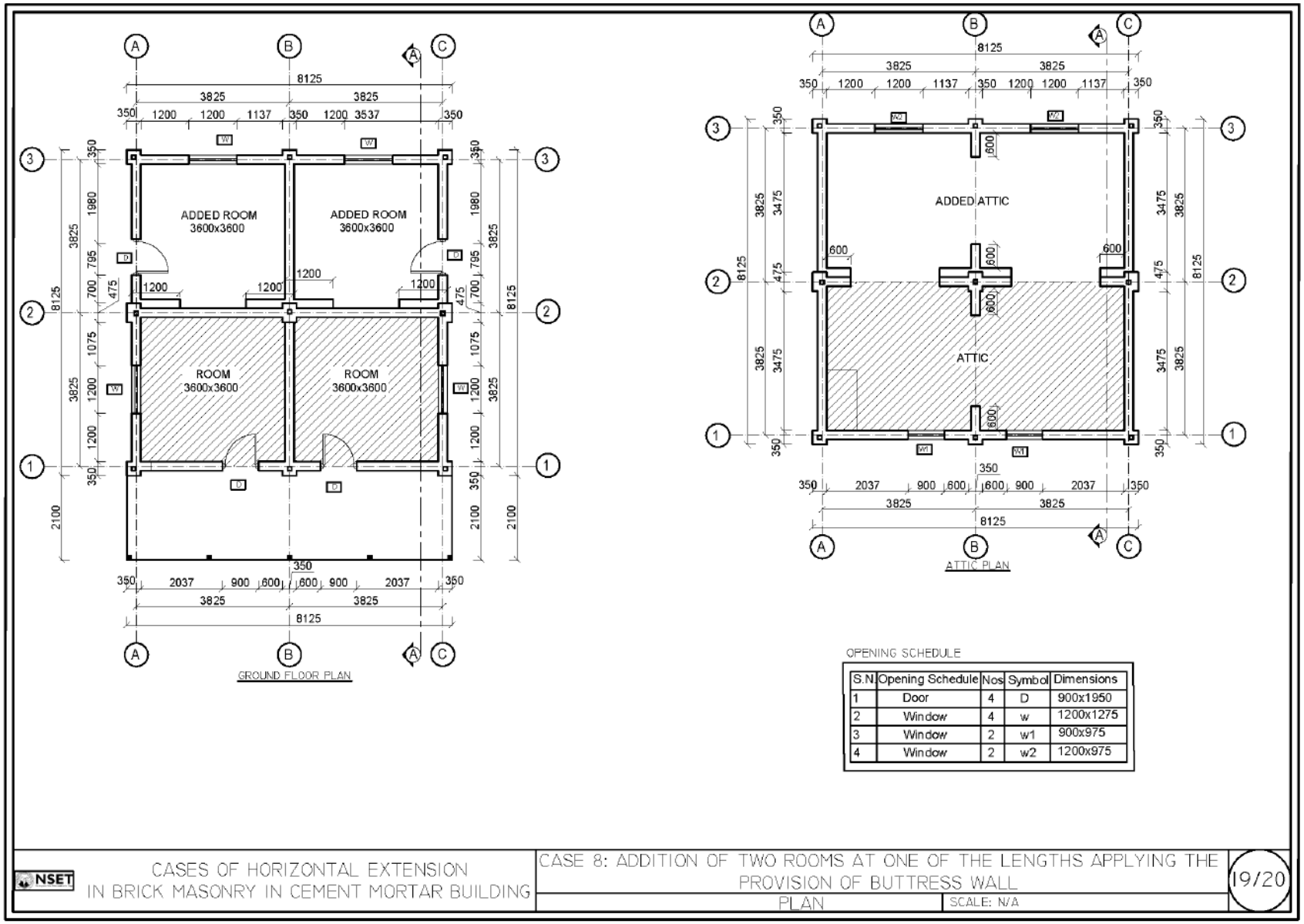

FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
75 MM THK ROOF BAND
WOODEN FLOOR 6"X6" WOODEN BEAM
ATTIC
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
BAND-CONNECTOR
PLINTH BAND
VERANDAH
GL
4125
75
600
450
375
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 5: ADDITION OF WING WALLS TO FORM A L- VERANDAH
APPLYING THE PROVISION OF BAND-CONNECTOR
ELEVATION & SECTION
SCALE: N/A
14/20

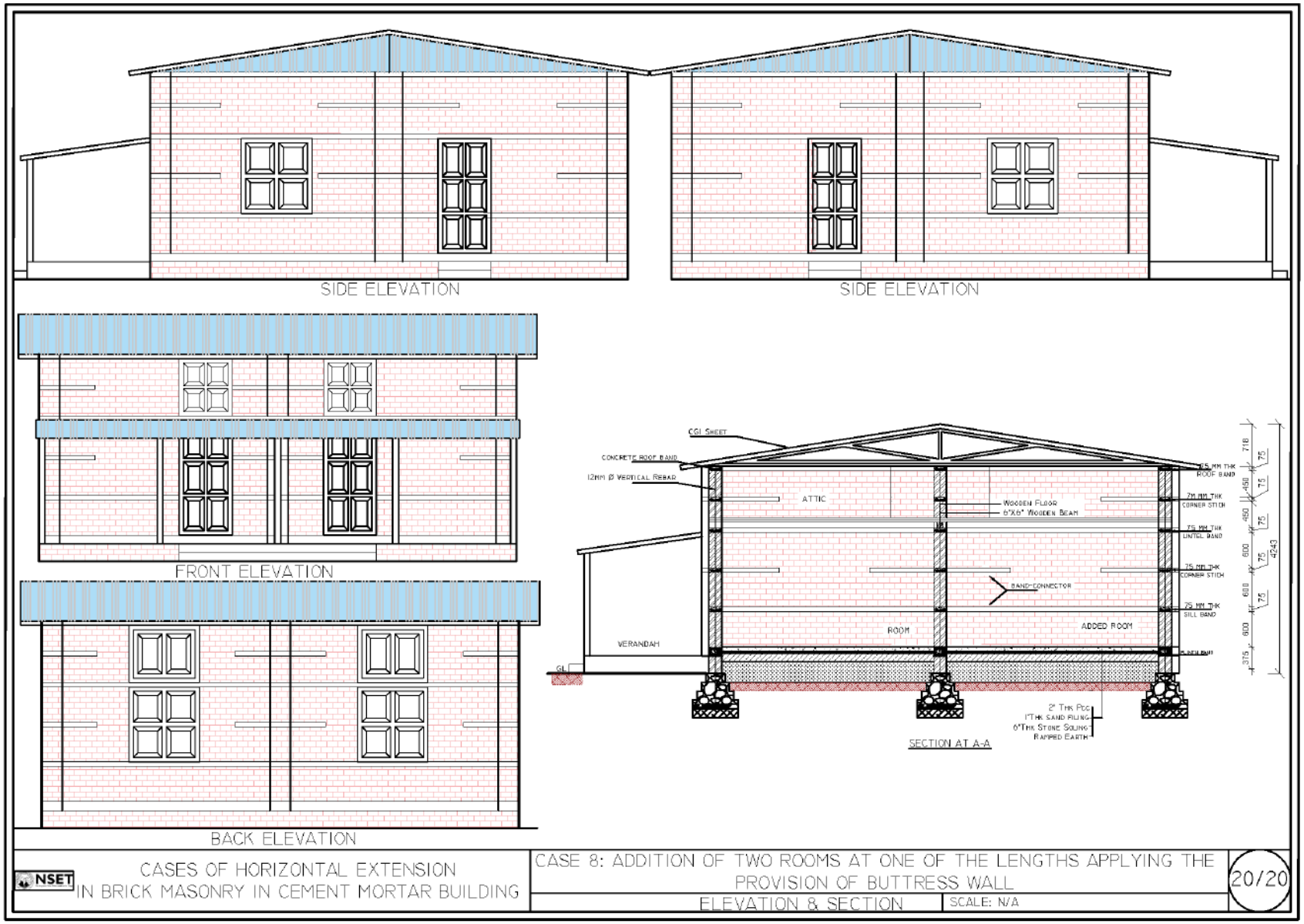

A
B
C
8125
3825
3825
350
1350
900
1350
225
3600
350
2
1
ROOM
3600x3600
ROOM
3600x3600
VARENDAH
4300
3825
1200
1200
1200
350
2100
350
2037
900
600
600
900
2037
350
3825
350
3825
8125
GROUND FLOOR PLAN
ROOF PLAN
OPENING SCHEDULE
S.N. | Opening Schedule | Nos | Symbol | Dimensions
1 | Door | 3 | D | 900x1950
2 | Window | 2 | w | 1200x1275
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 6: REPLACING LIGHT ROOFING WITH RC ROOFING
PLAN
SCALE: N/A
15/20

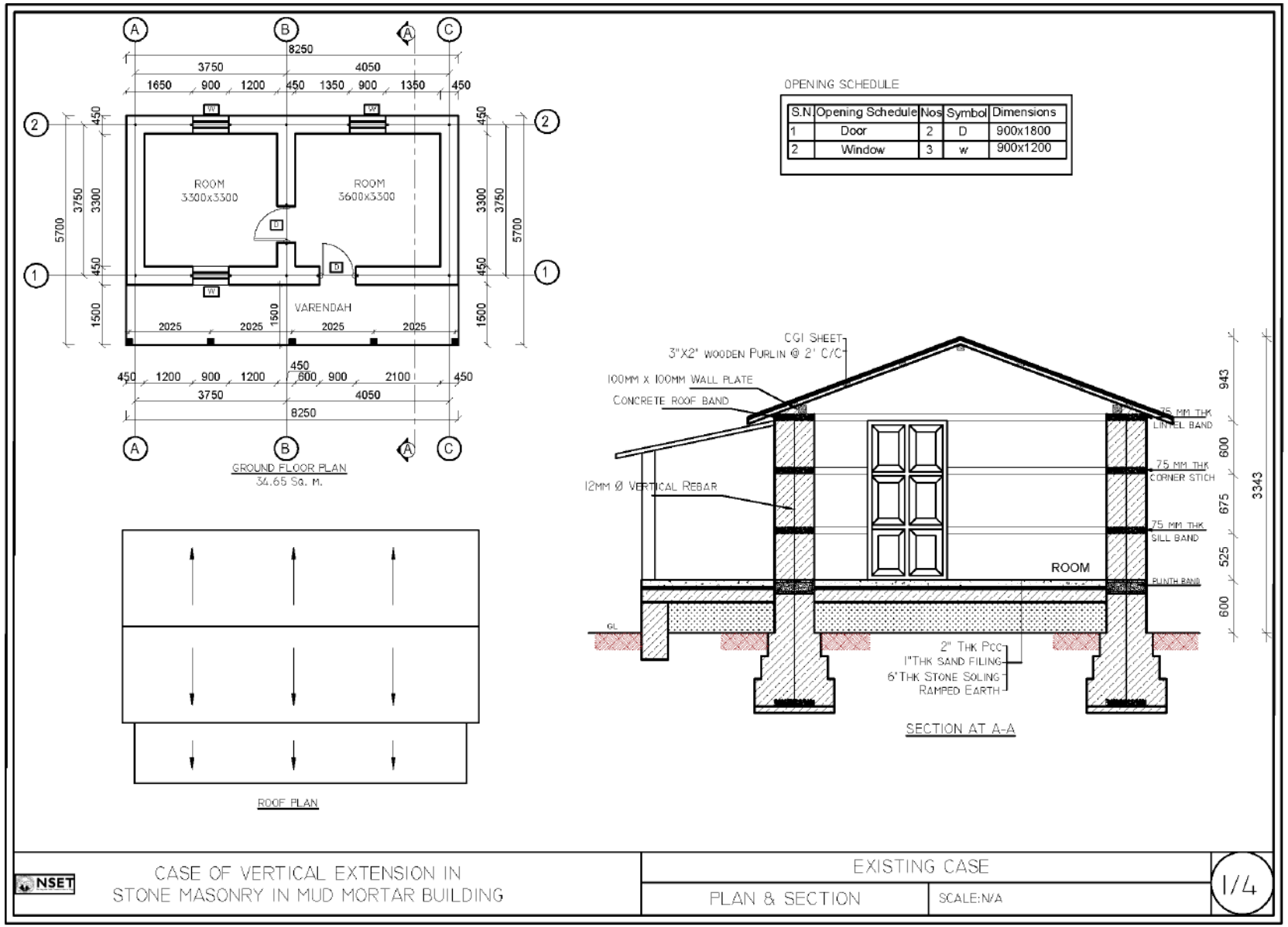

FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
VERANDAH
GL
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
PLINTH BAND
350
450
75
600
75
600
75
600
450
3275
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 6 :REPLACING LIGHT ROOFING WITH RC ROOFING
ELEVATION & SECTION
SCALE: N/A
16/20

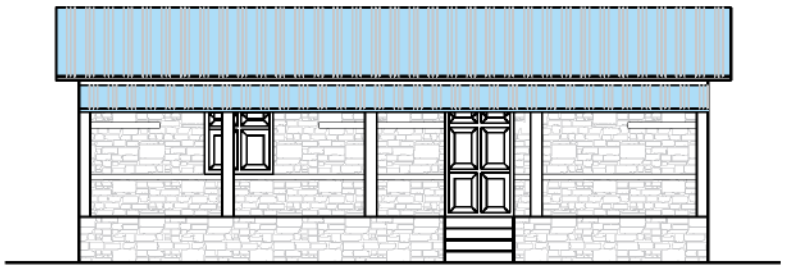

ROOM 3600x3600
ROOM 3600x3600
ADDED ROOM 3600x3600
VARENDAH
GROUND FLOOR PLAN
OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 4 D 900x1950
2 Window 3 w 1200x1275
3 Window 3 w1 900x975
ATTIC
ADDED ATTIC
ATTIC PLAN
NSET
CASES OF HORIZONTAL EXTENSION IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 7: ADDITION OF A ROOMS AT ONE OF THE WIDTH APPLYING THE PROVISION OF BUTTRESS WALL WITH SAME ROOF CONTINUATION
PLAN
SCALE: N/A
17/20


FRONT ELEVATION
SIDE ELEVATION
BACK ELEVATION
SIDE ELEVATION
CGI SHEET
CONCRETE ROOF BAND
12mm Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK ROOF BAND
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
BAND-CONNECTOR
75 MM THK SILL BAND
VERANDAH
PLINTH BAND
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
SECTION AT A-A
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 7: ADDITION OF A ROOMS AT ONE OF THE WIDTH APPLYING THE PROVISION OF BUTTRESS WALL WITH SAME ROOF CONTINUATION
ELEVATION & SECTION
SCALE: N/A
18/20

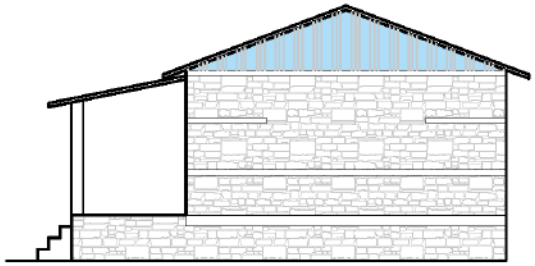

ADDED ROOM
3600x3600
ADDED ROOM
3600x3600
ROOM
3600x3600
ROOM
3600x3600
GROUND FLOOR PLAN
ADDED ATTIC
ATTIC
ATTIC PLAN
OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 4 D 900x1950
2 Window 4 w 1200x1275
3 Window 2 w1 900x975
4 Window 2 w2 1200x975
NSET
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 8: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS APPLYING THE PROVISION OF BUTTRESS WALL
PLAN
SCALE: N/A
19/20


SIDE ELEVATION
SIDE ELEVATION
FRONT ELEVATION
BACK ELEVATION
CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK ROOF BAND
75 MM THK CORNER STITCH
75 MM THK LINTEL BAND
75 MM THK CORNER STITCH
75 MM THK SILL BAND
BAND-CONNECTOR
ROOM
ADDED ROOM
VERANDAH
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMMED EARTH
SECTION AT A-A
718
75
450
75
450
75
600
75
610
75
600
375
4243
CASES OF HORIZONTAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE 8: ADDITION OF TWO ROOMS AT ONE OF THE LENGTHS APPLYING THE PROVISION OF BUTTRESS WALL
ELEVATION & SECTION
SCALE: N/A
20/20

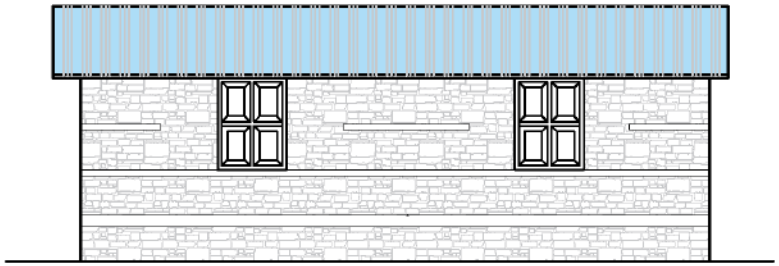

OPENING SCHEDULE
S.N. Opening Schedule Nos. Symbol Dimensions
1 Door 2 D 900x1800
2 Window 3 w 900x1200
ROOM 3300x3300
ROOM 3600x3300
VARENDAH
GROUND FLOOR PLAN
34.65 Sq. m.
ROOF PLAN
CGI SHEET
3"X2" WOODEN PURLIN @ 2' C/C
100MM X 100MM WALL PLATE
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
PLINTH BAND
ROOM
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
SECTION AT A-A
CASE OF VERTICAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
EXISTING CASE
PLAN & SECTION
SCALE:N/A
1/4



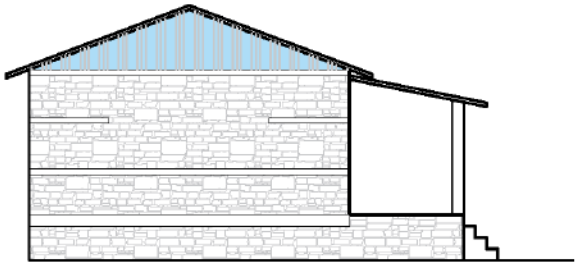
FRONT ELEVATION



SIDE ELEVATION



BACK ELEVATION



SIDE ELEVATION

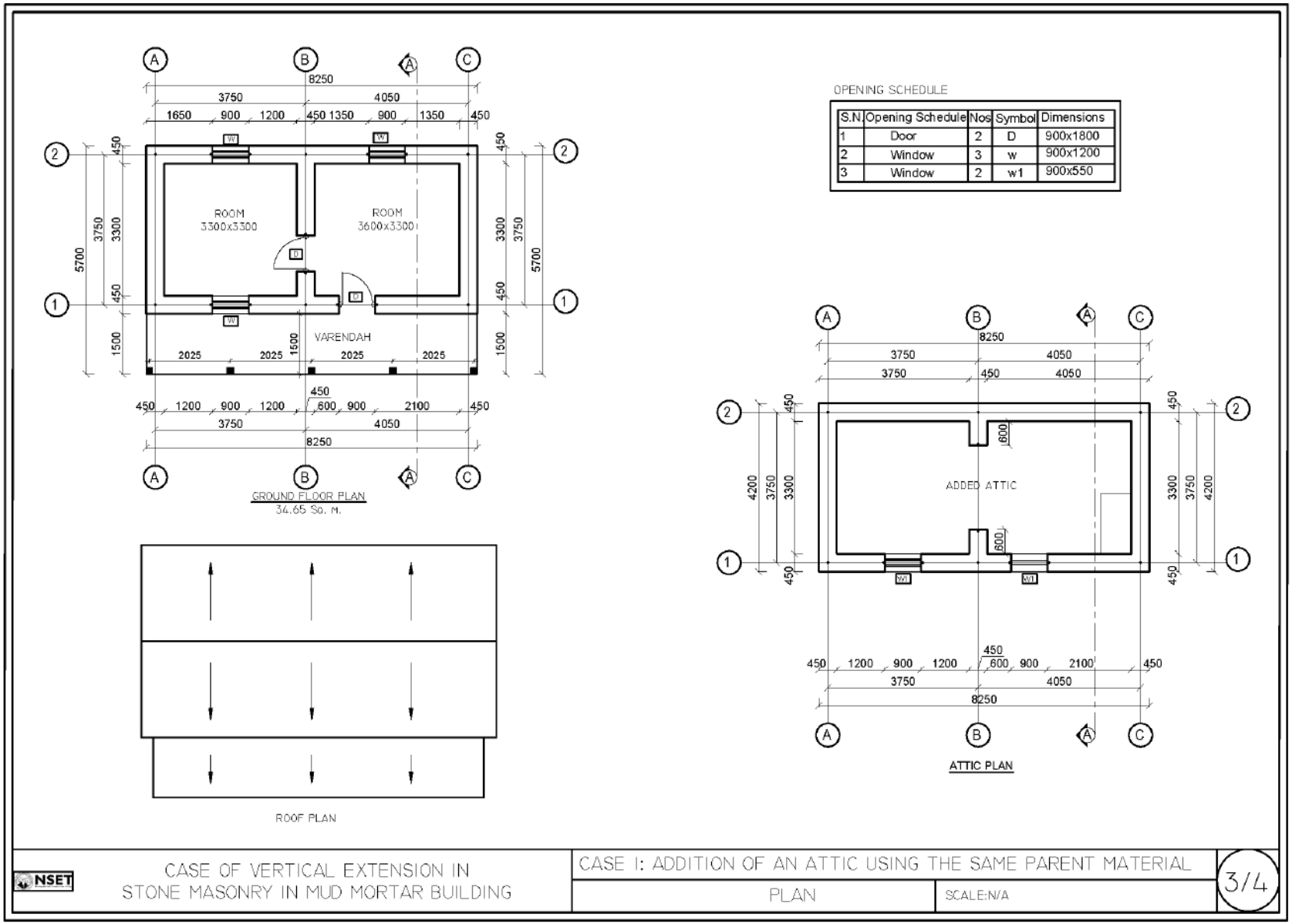
NSET

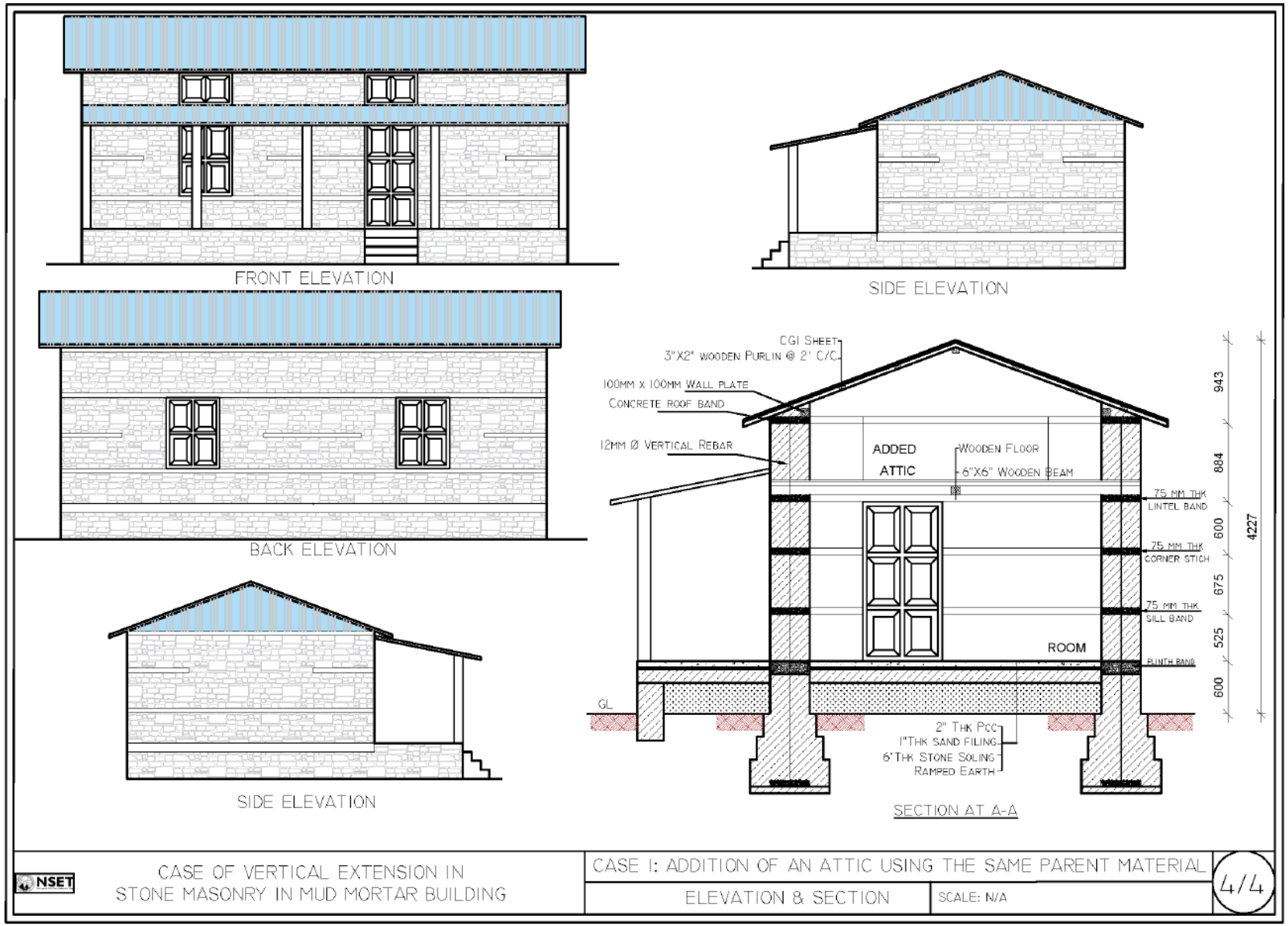
CASE OF VERTICAL EXTENSION IN
STONE MASONRY IN MUD MORTAR BUILDING

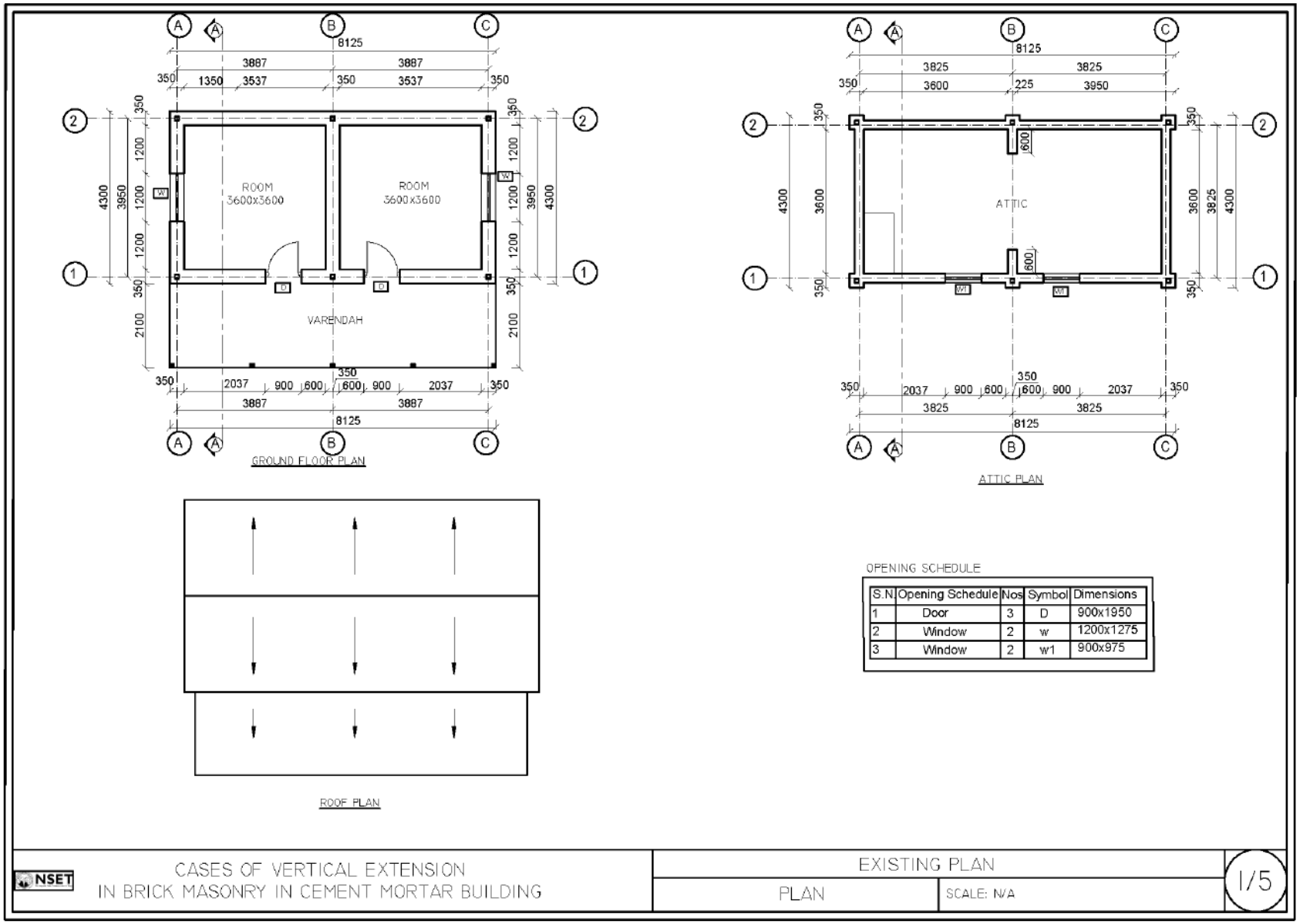
EXISTING CASE

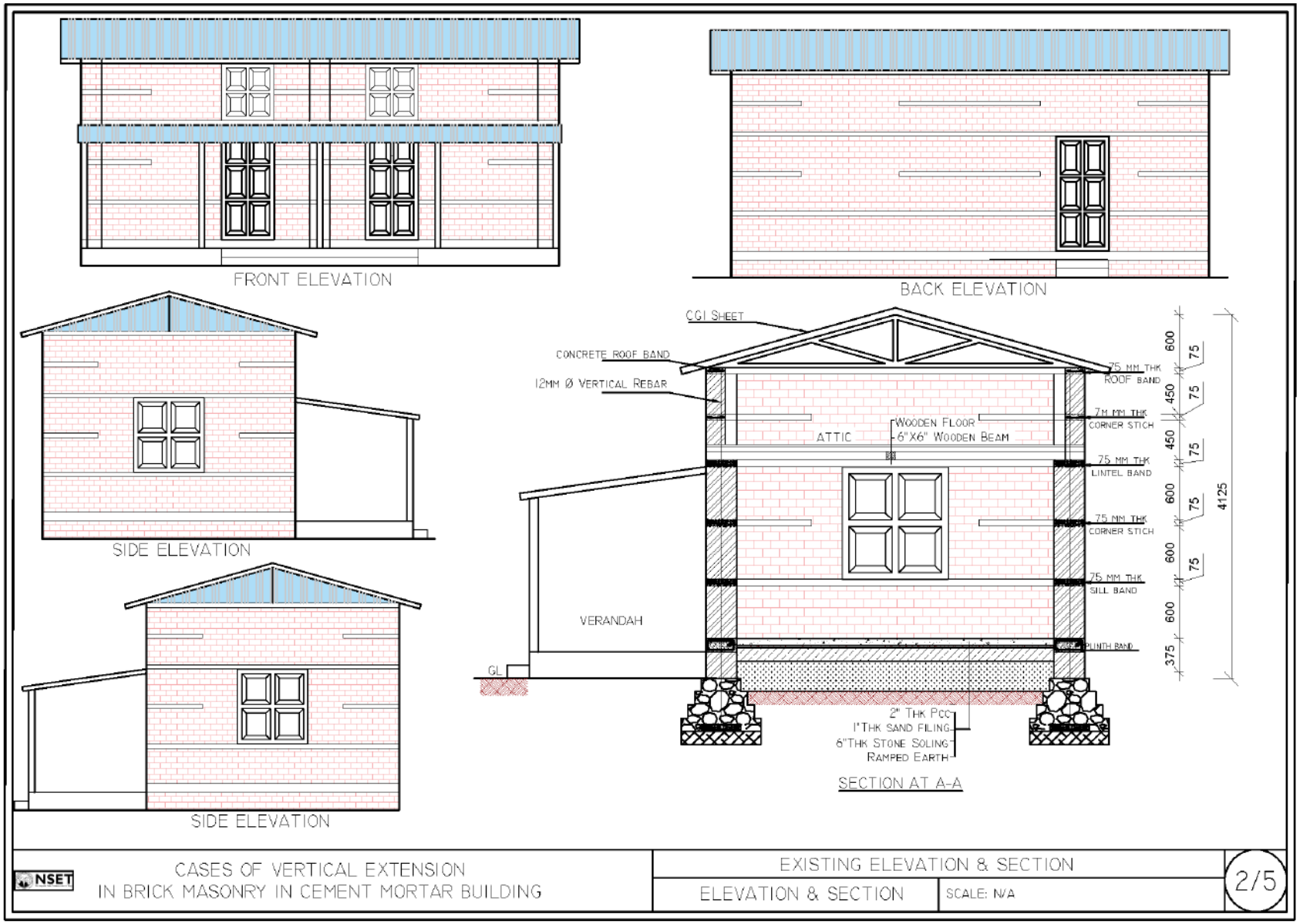
ELEVATION | SCALE:N/A

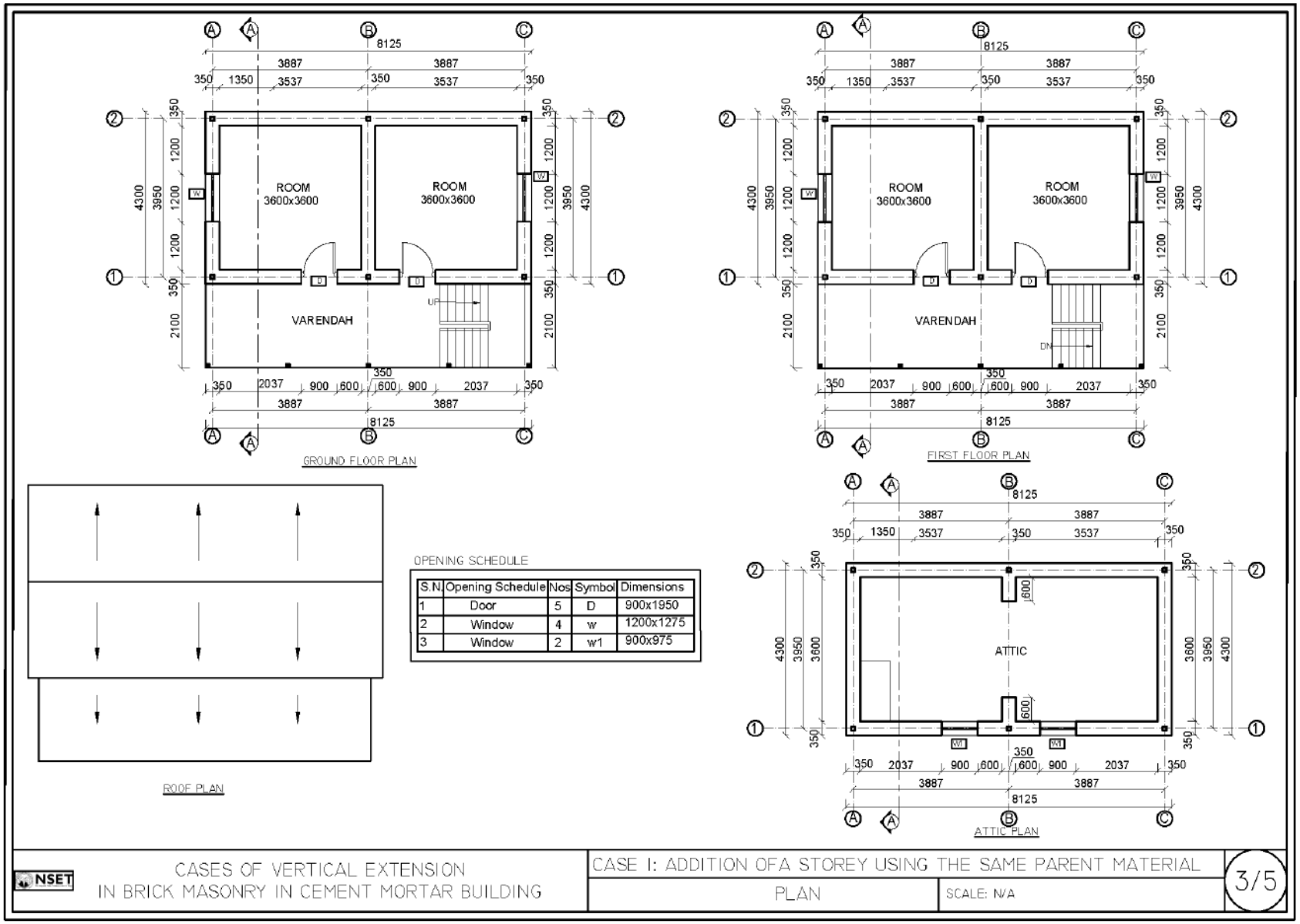
2/4


OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 2 D 900x1800
2 Window 3 w 900x1200
3 Window 2 w1 900x550
ROOM 3300x3300
ROOM 3600x3300
VARENDAH
GROUND FLOOR PLAN
34.65 Sq. M.
ROOF PLAN
ADDED ATTIC
ATTIC PLAN
CASE OF VERTICAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
CASE I: ADDITION OF AN ATTIC USING THE SAME PARENT MATERIAL
PLAN
SCALE:N/A
3/4

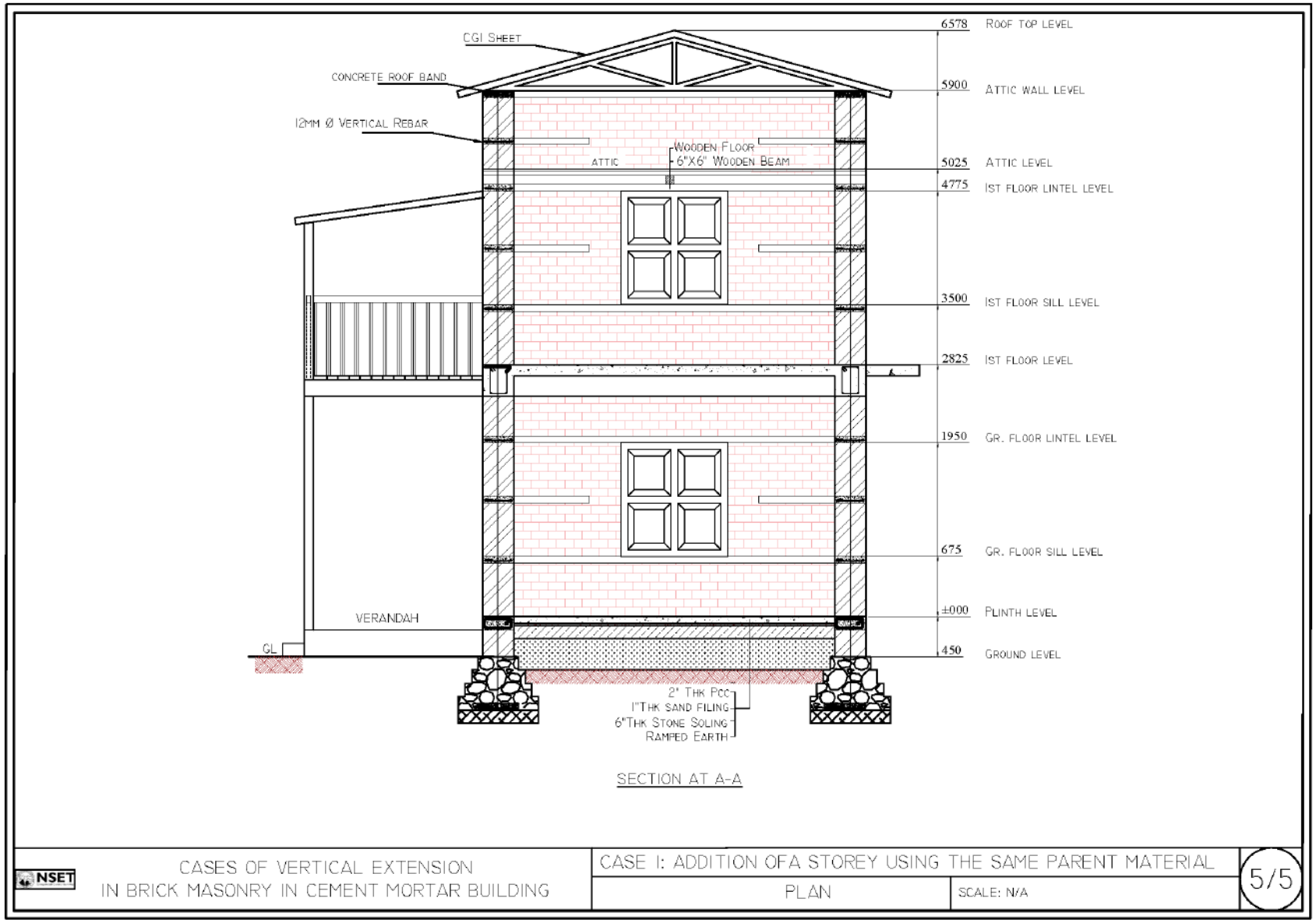

FRONT ELEVATION
SIDE ELEVATION
BACK ELEVATION
SIDE ELEVATION
CGI SHEET
3"X2" WOODEN PURLIN @ 2' C/C
100MM x 100MM WALL PLATE
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ADDED ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
ROOM
PLINTH BAND
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
943
884
600
675
525
600
4227
SECTION AT A-A
NSET
CASE OF VERTICAL EXTENSION IN STONE MASONRY IN MUD MORTAR BUILDING
CASE I: ADDITION OF AN ATTIC USING THE SAME PARENT MATERIAL
ELEVATION & SECTION
SCALE: N/A
4/4

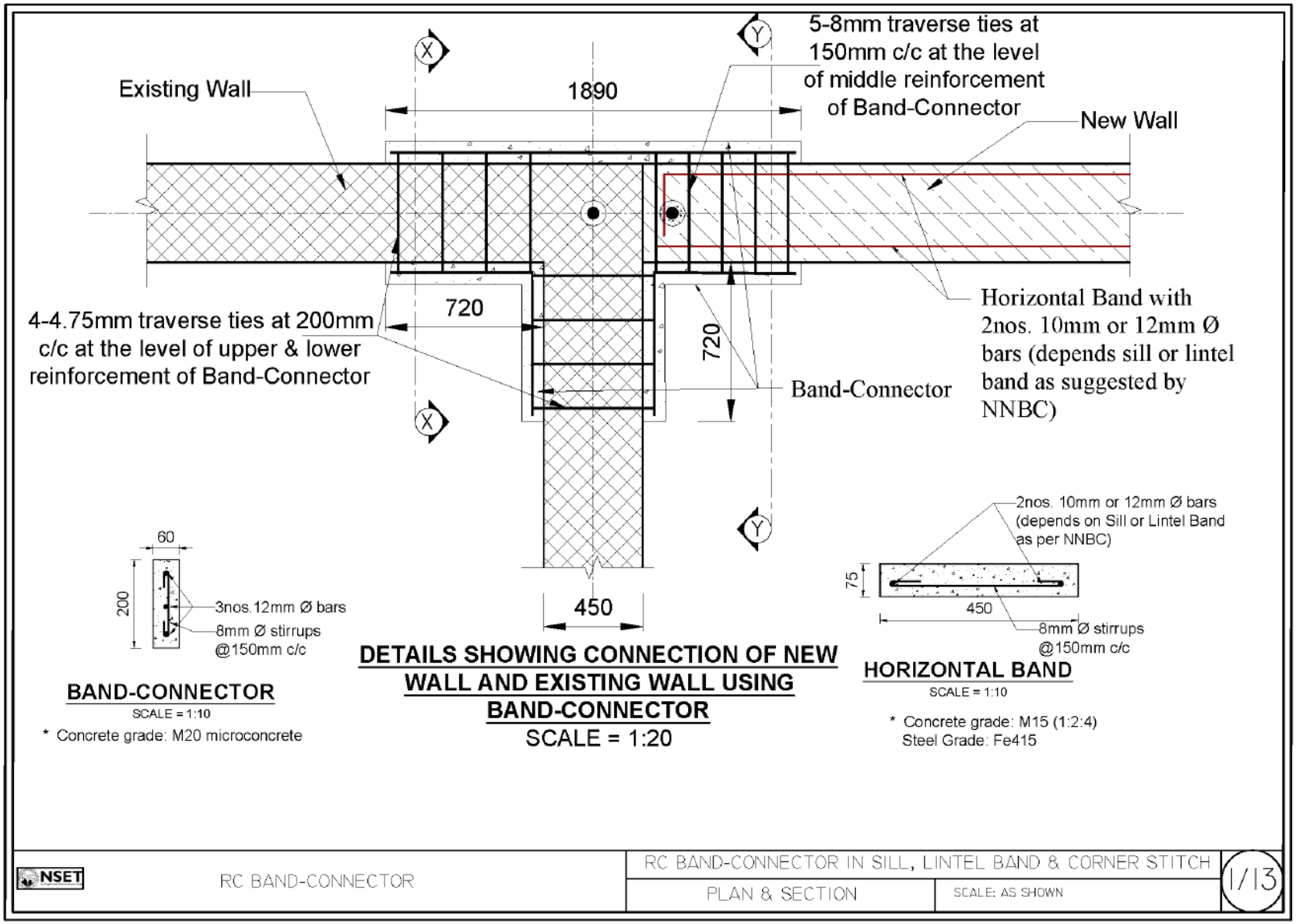

ROOM
3600x3600
ROOM
3600x3600
VARENDAH
GROUND FLOOR PLAN
ATTIC
ATTIC PLAN
ROOF PLAN
OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 3 D 900x1950
2 Window 2 w 1200x1275
3 Window 2 w1 900x975
NSET
CASES OF VERTICAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
EXISTING PLAN
PLAN
SCALE: N/A
1/5

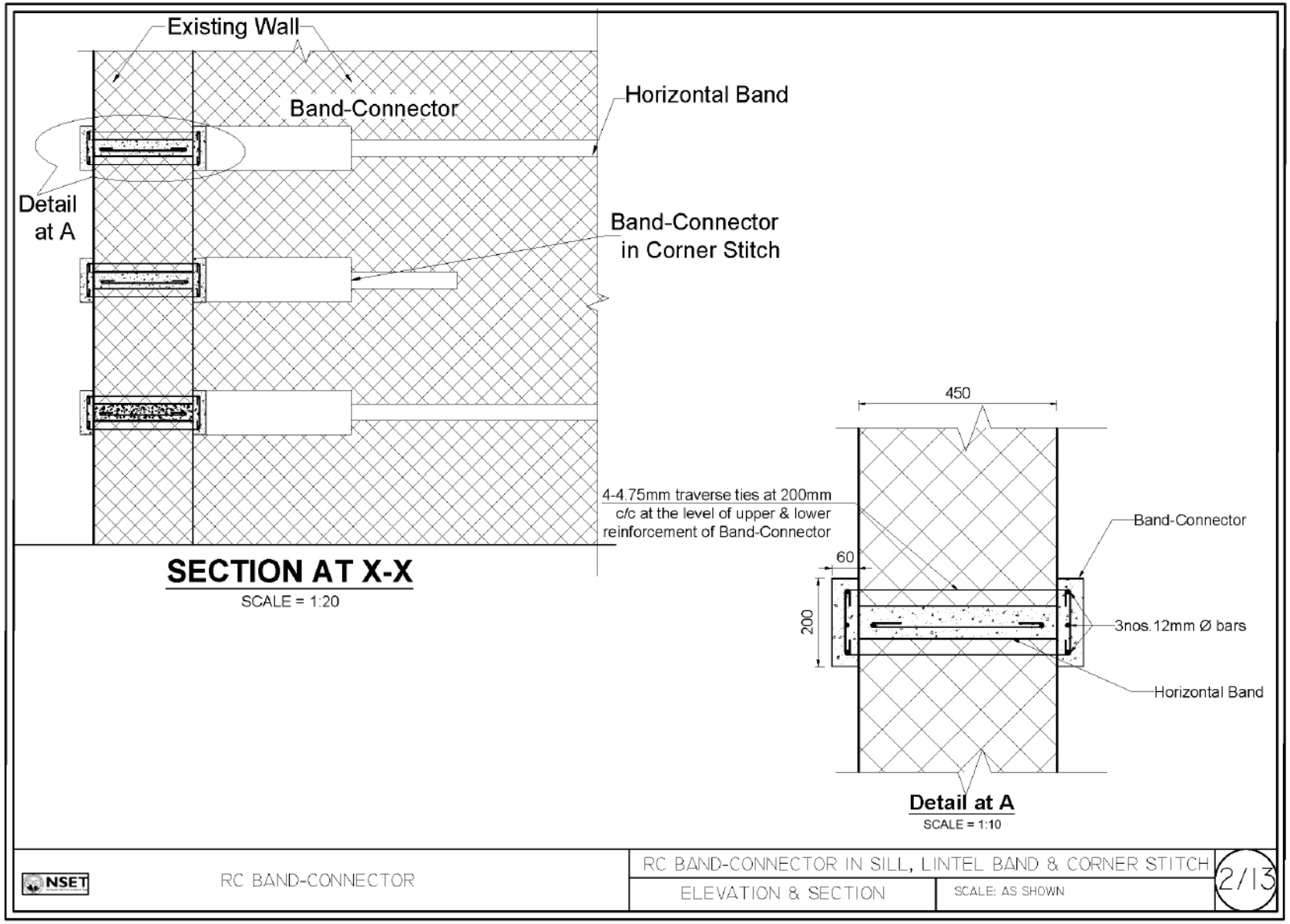

FRONT ELEVATION
BACK ELEVATION
SIDE ELEVATION
SIDE ELEVATION
CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
75 MM THK ROOF BAND
7M MM THK CORNER STICH
75 MM THK LINTEL BAND
75 MM THK CORNER STICH
75 MM THK SILL BAND
PLINTH BAND
VERANDAH
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
SECTION AT A-A
600
75
450
75
450
75
600
75
600
75
600
375
4125
NSET
CASES OF VERTICAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
EXISTING ELEVATION & SECTION
ELEVATION & SECTION
SCALE: N/A
2/5

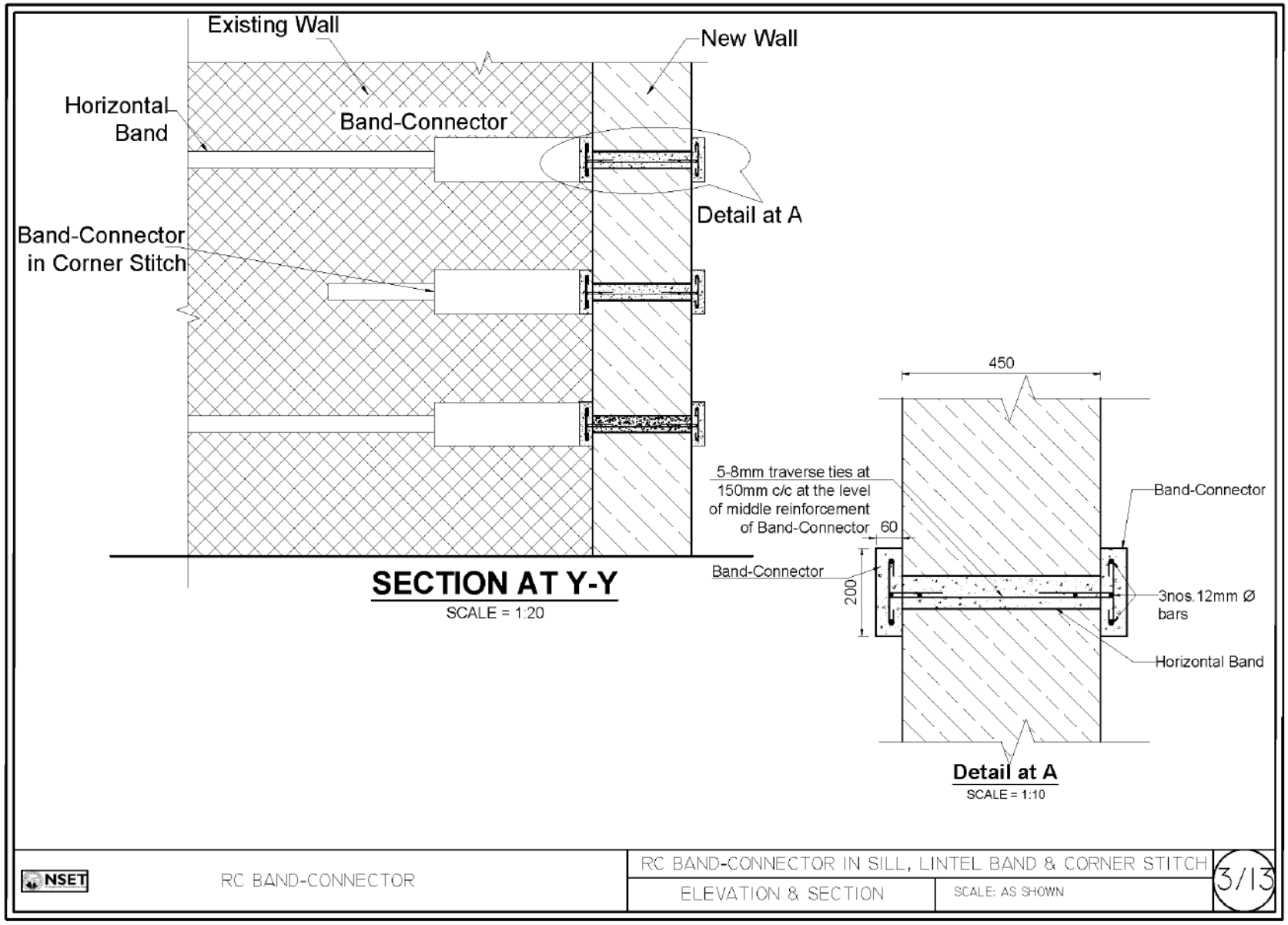

ROOM 3600x3600
ROOM 3600x3600
VARENDAH
UP
GROUND FLOOR PLAN
FIRST FLOOR PLAN
ATTIC
ATTIC PLAN
ROOF PLAN
OPENING SCHEDULE
S.N. Opening Schedule Nos Symbol Dimensions
1 Door 5 D 900x1950
2 Window 4 w 1200x1275
3 Window 2 w1 900x975
NSET
CASES OF VERTICAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE I: ADDITION OFA STOREY USING THE SAME PARENT MATERIAL
PLAN
SCALE: N/A
3/5

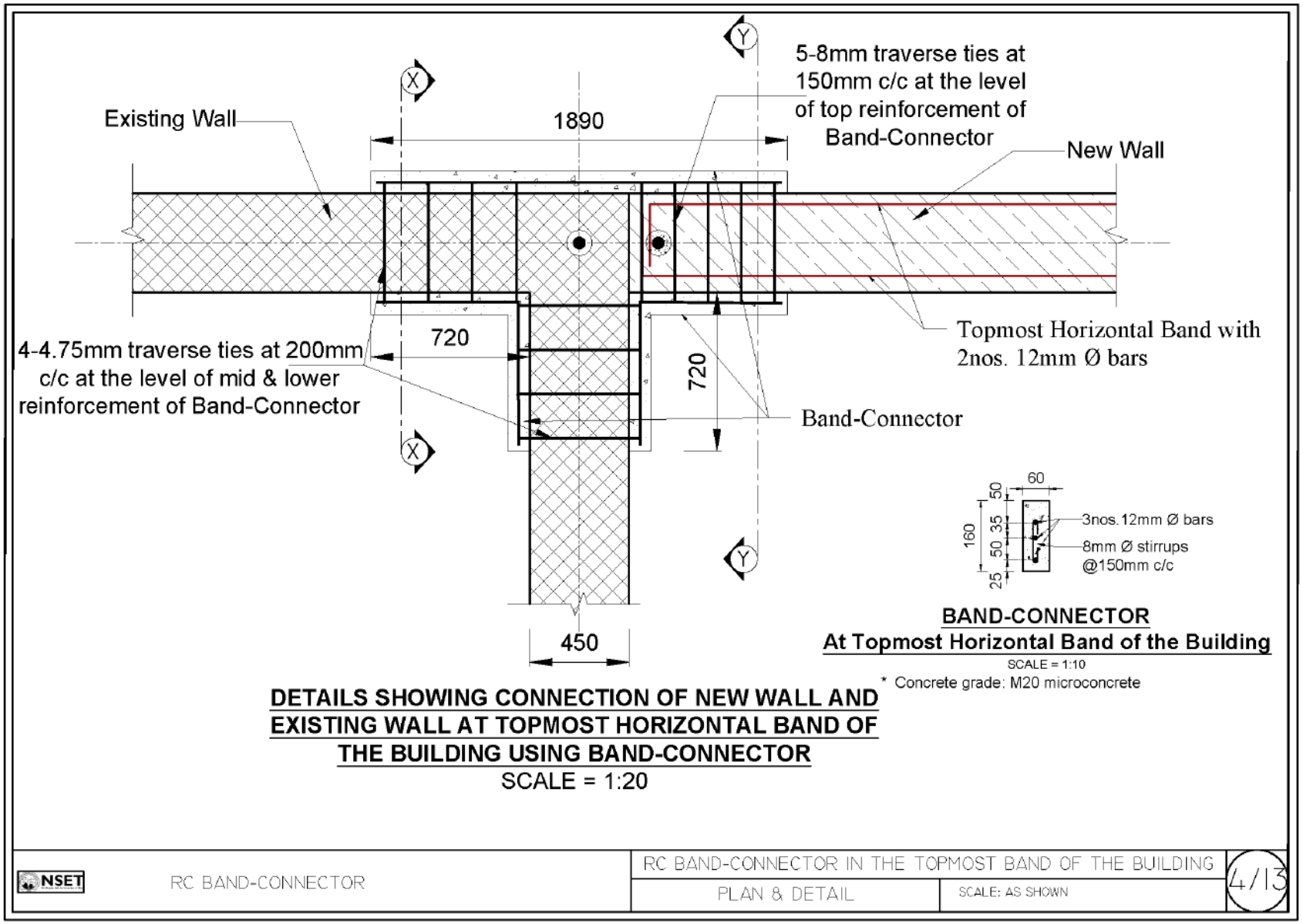

FRONT ELEVATION
SIDE ELEVATION
BACK ELEVATION
SIDE ELEVATION
NSET
CASES OF VERTICAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE I: ADDITION OFA STOREY USING THE SAME PARENT MATERIAL
PLAN
SCALE: N/A
4/5

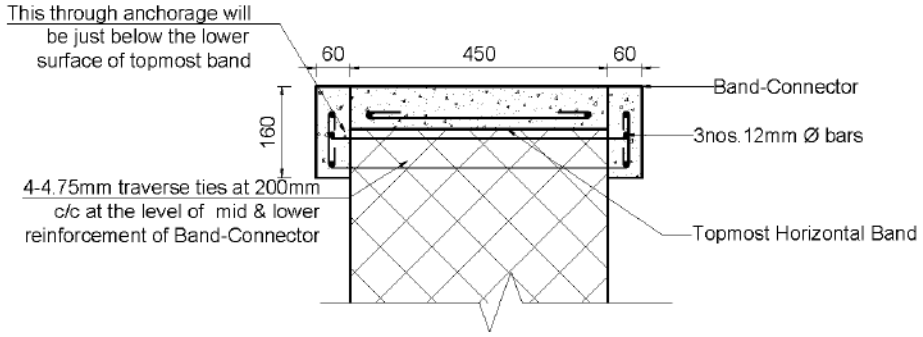

CGI SHEET
CONCRETE ROOF BAND
12MM Ø VERTICAL REBAR
ATTIC
WOODEN FLOOR
6"X6" WOODEN BEAM
VERANDAH
GL
2" THK PCC
1"THK SAND FILING
6"THK STONE SOLING
RAMPED EARTH
6578 ROOF TOP LEVEL
5900 ATTIC WALL LEVEL
5025 ATTIC LEVEL
4775 IST FLOOR LINTEL LEVEL
3500 IST FLOOR SILL LEVEL
2825 IST FLOOR LEVEL
1950 GR. FLOOR LINTEL LEVEL
675 GR. FLOOR SILL LEVEL
±000 PLINTH LEVEL
450 GROUND LEVEL
SECTION AT A-A
NSET
CASES OF VERTICAL EXTENSION
IN BRICK MASONRY IN CEMENT MORTAR BUILDING
CASE I: ADDITION OFA STOREY USING THE SAME PARENT MATERIAL
PLAN
SCALE: N/A
5/5


Existing Wall
1890
5-8mm traverse ties at 150mm c/c at the level of middle reinforcement of Band-Connector
New Wall
4-4.75mm traverse ties at 200mm c/c at the level of upper & lower reinforcement of Band-Connector
720
720
Band-Connector
Horizontal Band with 2nos. 10mm or 12mm Ø bars (depends sill or lintel band as suggested by NNBC)
X
X
Y
Y
450
60
200
3nos.12mm Ø bars
8mm Ø stirrups @150mm c/c
BAND-CONNECTOR
SCALE = 1:10
* Concrete grade: M20 microconcrete
DETAILS SHOWING CONNECTION OF NEW WALL AND EXISTING WALL USING BAND-CONNECTOR
SCALE = 1:20
2nos. 10mm or 12mm Ø bars (depends on Sill or Lintel Band as per NNBC)
75
450
8mm Ø stirrups @150mm c/c
HORIZONTAL BAND
SCALE = 1:10
* Concrete grade: M15 (1:2:4)
Steel Grade: Fe415
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR IN SILL, LINTEL BAND & CORNER STITCH
PLAN & SECTION
SCALE: AS SHOWN
1/13

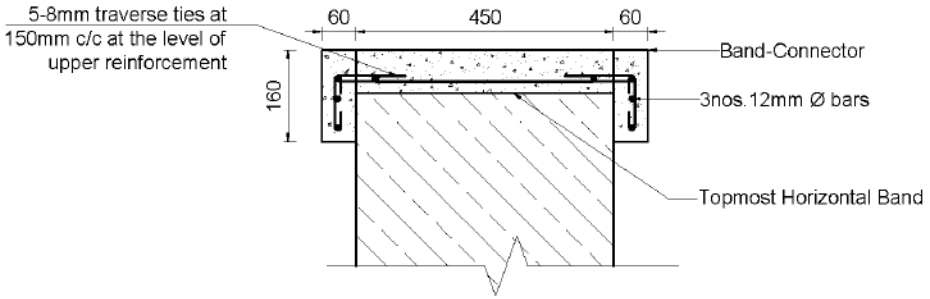

Existing Wall
Band-Connector
Horizontal Band
Detail at A
Band-Connector in Corner Stitch
4-4.75mm traverse ties at 200mm c/c at the level of upper & lower reinforcement of Band-Connector
SECTION AT X-X
SCALE = 1:20
450
60
200
Band-Connector
3nos.12mm Ø bars
Horizontal Band
Detail at A
SCALE = 1:10
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR IN SILL, LINTEL BAND & CORNER STITCH
ELEVATION & SECTION
SCALE: AS SHOWN
2/13


Existing Wall
New Wall
Horizontal Band
Band-Connector
Detail at A
Band-Connector in Corner Stitch
SECTION AT Y-Y
SCALE = 1:20
450
5-8mm traverse ties at 150mm c/c at the level of middle reinforcement of Band-Connector
60
Band-Connector
200
Band-Connector
3nos.12mm Ø bars
Horizontal Band
Detail at A
SCALE = 1:10
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR IN SILL, LINTEL BAND & CORNER STITCH
ELEVATION & SECTION
SCALE: AS SHOWN
3/13

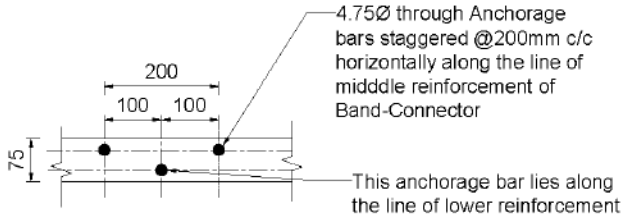

Existing Wall
1890
5-8mm traverse ties at 150mm c/c at the level of top reinforcement of Band-Connector
New Wall
Topmost Horizontal Band with 2nos. 12mm Ø bars
4-4.75mm traverse ties at 200mm c/c at the level of mid & lower reinforcement of Band-Connector
720
720
Band-Connector
450
60
50
35
50
160
25
3nos. 12mm Ø bars
8mm Ø stirrups @150mm c/c
BAND-CONNECTOR
At Topmost Horizontal Band of the Building
SCALE = 1:10
* Concrete grade: M20 microconcrete
DETAILS SHOWING CONNECTION OF NEW WALL AND EXISTING WALL AT TOPMOST HORIZONTAL BAND OF THE BUILDING USING BAND-CONNECTOR
SCALE = 1:20
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR IN THE TOPMOST BAND OF THE BUILDING
PLAN & DETAIL
SCALE: AS SHOWN
4/13



SECTION AT X-X
SCALE = 1:10

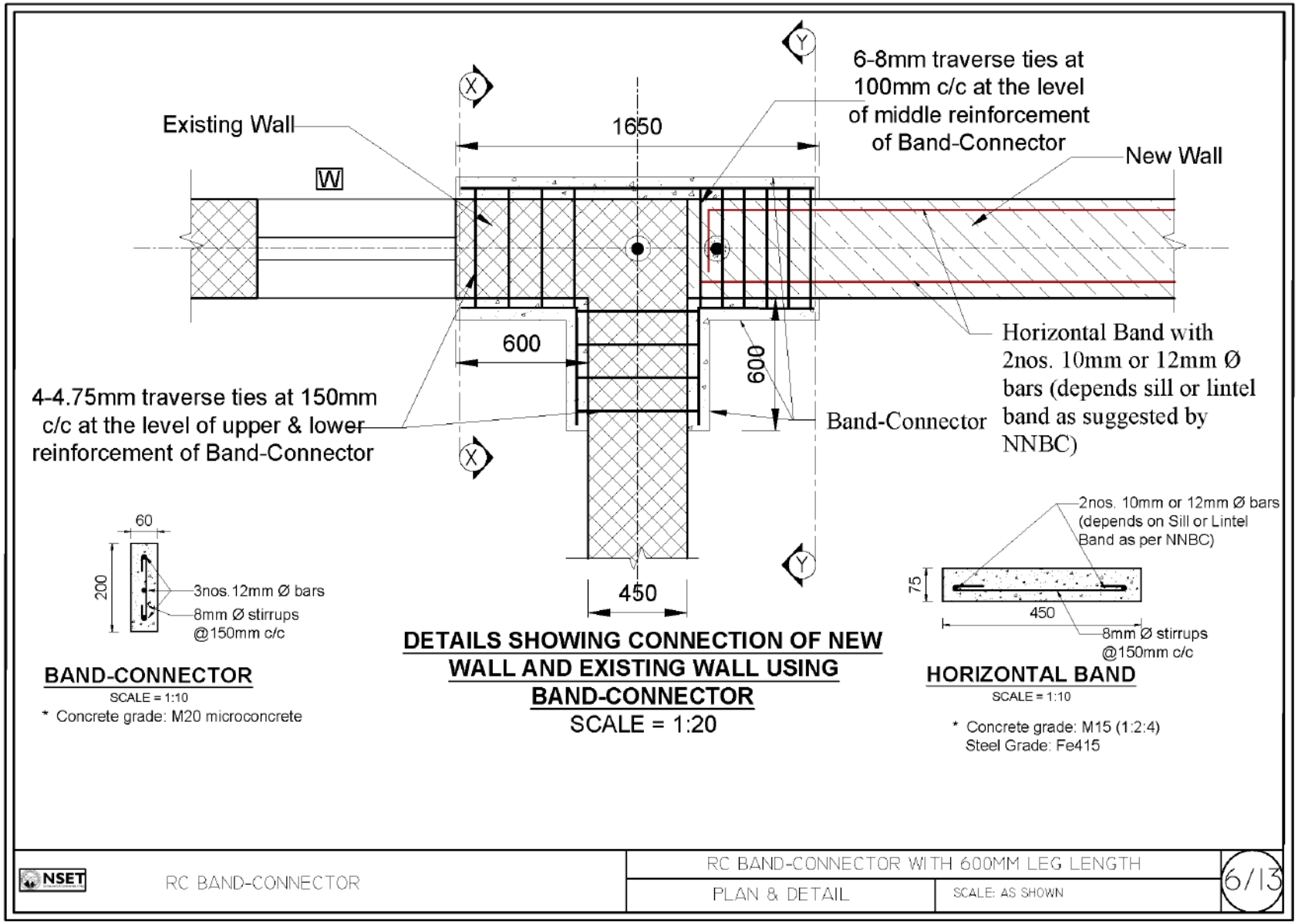


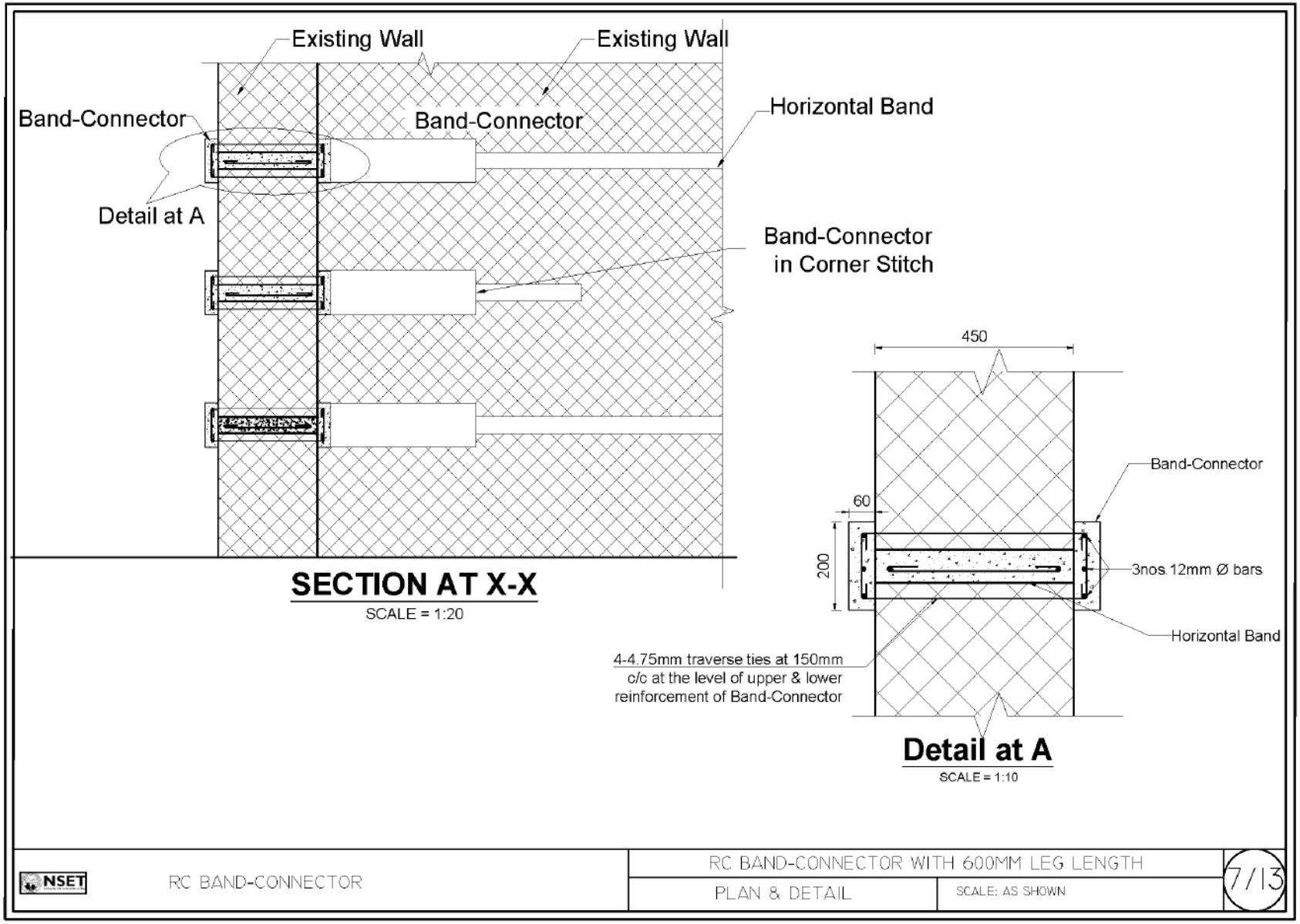
SECTION AT Y-Y
SCALE = 1:10

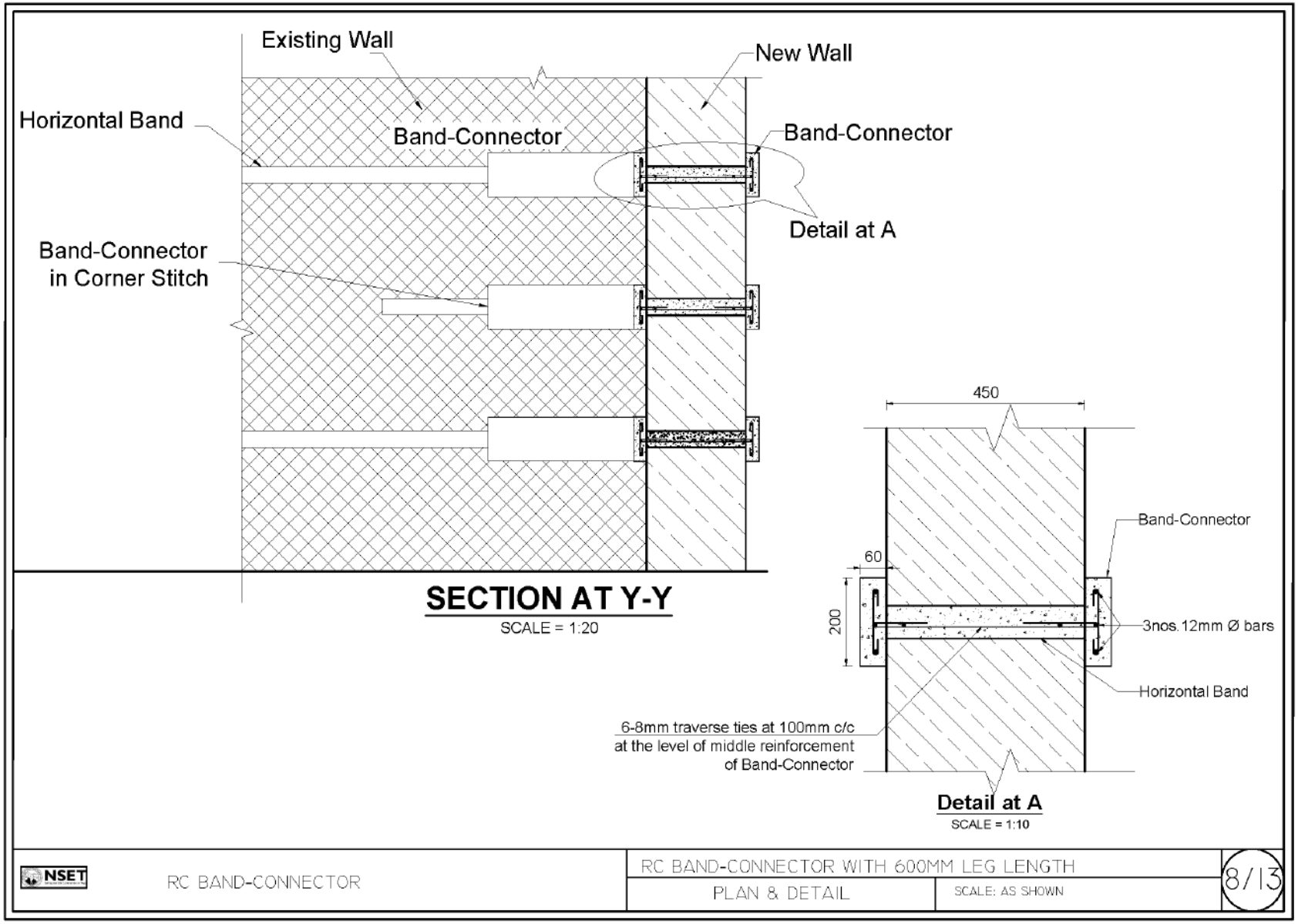


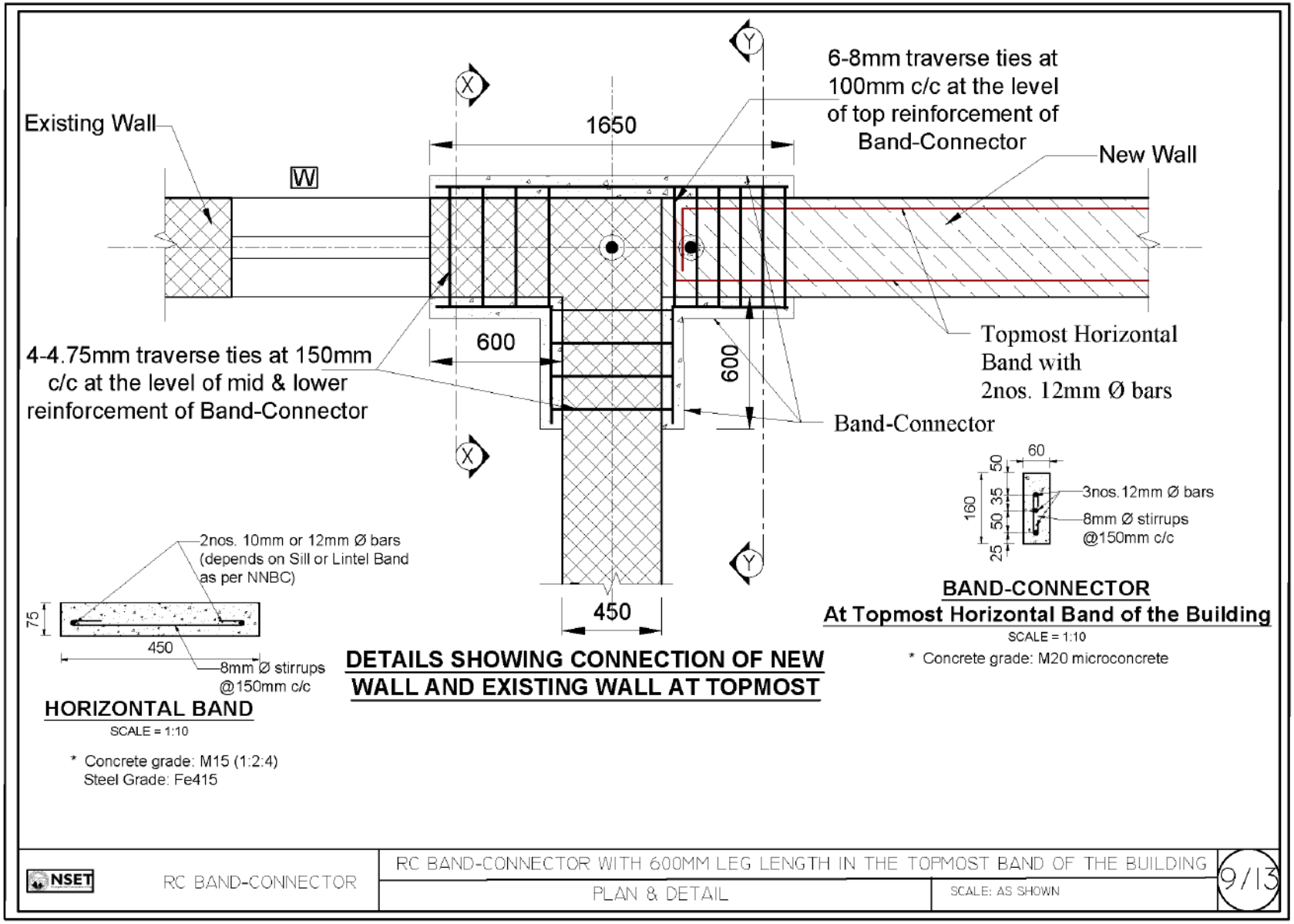
LAYOUT OF ANCHORAGE BARS PROVIDED TO CONNECT BAND-CONNECTOR WITH EXISTING WALL
(SCALE 1:20)

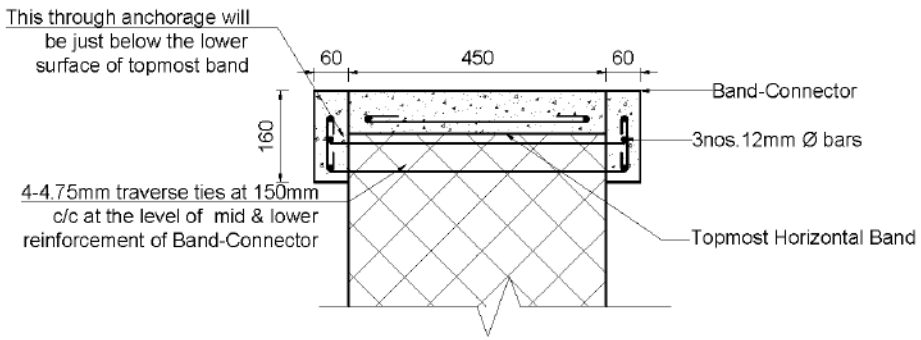
NSET	RC BAND-CONNECTOR	RC BAND-CONNECTOR IN THE TOPMOST BAND OF THE BUILDING	5/13
		SECTION & DETAIL / SCALE: AS SHOWN	


Existing Wall
W
1650
6-8mm traverse ties at 100mm c/c at the level of middle reinforcement of Band-Connector
New Wall
600
600
4-4.75mm traverse ties at 150mm c/c at the level of upper & lower reinforcement of Band-Connector
Band-Connector
Horizontal Band with 2nos. 10mm or 12mm Ø bars (depends sill or lintel band as suggested by NNBC)
X
Y
450
60
200
3nos.12mm Ø bars
8mm Ø stirrups @150mm c/c
BAND-CONNECTOR
SCALE = 1:10
* Concrete grade: M20 microconcrete
DETAILS SHOWING CONNECTION OF NEW WALL AND EXISTING WALL USING BAND-CONNECTOR
SCALE = 1:20
2nos. 10mm or 12mm Ø bars (depends on Sill or Lintel Band as per NNBC)
75
450
8mm Ø stirrups @150mm c/c
HORIZONTAL BAND
SCALE = 1:10
* Concrete grade: M15 (1:2:4)
Steel Grade: Fe415
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR WITH 600MM LEG LENGTH
PLAN & DETAIL
SCALE: AS SHOWN
6/13

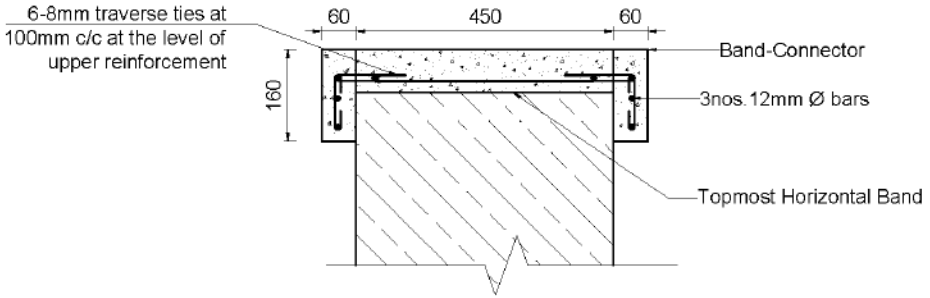

Existing Wall
Existing Wall
Band-Connector
Band-Connector
Horizontal Band
Detail at A
Band-Connector
in Corner Stitch
SECTION AT X-X
SCALE = 1:20
450
Band-Connector
60
200
3nos.12mm Ø bars
Horizontal Band
4-4.75mm traverse ties at 150mm
c/c at the level of upper & lower
reinforcement of Band-Connector
Detail at A
SCALE = 1:10
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR WITH 600MM LEG LENGTH
PLAN & DETAIL
SCALE: AS SHOWN
7/13


Existing Wall
New Wall
Horizontal Band
Band-Connector
Band-Connector
Detail at A
Band-Connector
in Corner Stitch
SECTION AT Y-Y
SCALE = 1:20
450
Band-Connector
60
200
3nos.12mm Ø bars
Horizontal Band
6-8mm traverse ties at 100mm c/c
at the level of middle reinforcement
of Band-Connector
Detail at A
SCALE = 1:10
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR WITH 600MM LEG LENGTH
PLAN & DETAIL
SCALE: AS SHOWN
8/13

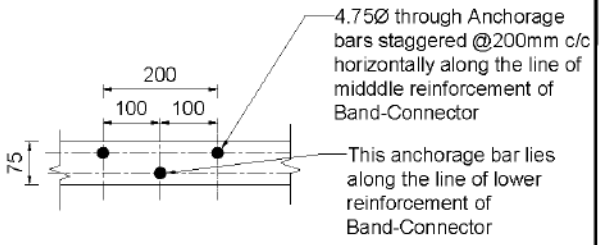

Existing Wall
W
X
Y
1650
6-8mm traverse ties at 100mm c/c at the level of top reinforcement of Band-Connector
New Wall
4-4.75mm traverse ties at 150mm c/c at the level of mid & lower reinforcement of Band-Connector
600
600
Topmost Horizontal Band with 2nos. 12mm Ø bars
Band-Connector
450
2nos. 10mm or 12mm Ø bars (depends on Sill or Lintel Band as per NNBC)
75
450
8mm Ø stirrups @150mm c/c
HORIZONTAL BAND
SCALE = 1:10
* Concrete grade: M15 (1:2:4)
Steel Grade: Fe415
DETAILS SHOWING CONNECTION OF NEW WALL AND EXISTING WALL AT TOPMOST
60
50
160
35
50
25
3nos.12mm Ø bars
8mm Ø stirrups @150mm c/c
BAND-CONNECTOR
At Topmost Horizontal Band of the Building
SCALE = 1:10
* Concrete grade: M20 microconcrete
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR WITH 600MM LEG LENGTH IN THE TOPMOST BAND OF THE BUILDING
PLAN & DETAIL
SCALE: AS SHOWN
9/13



SECTION AT X-X
SCALE = 1:10

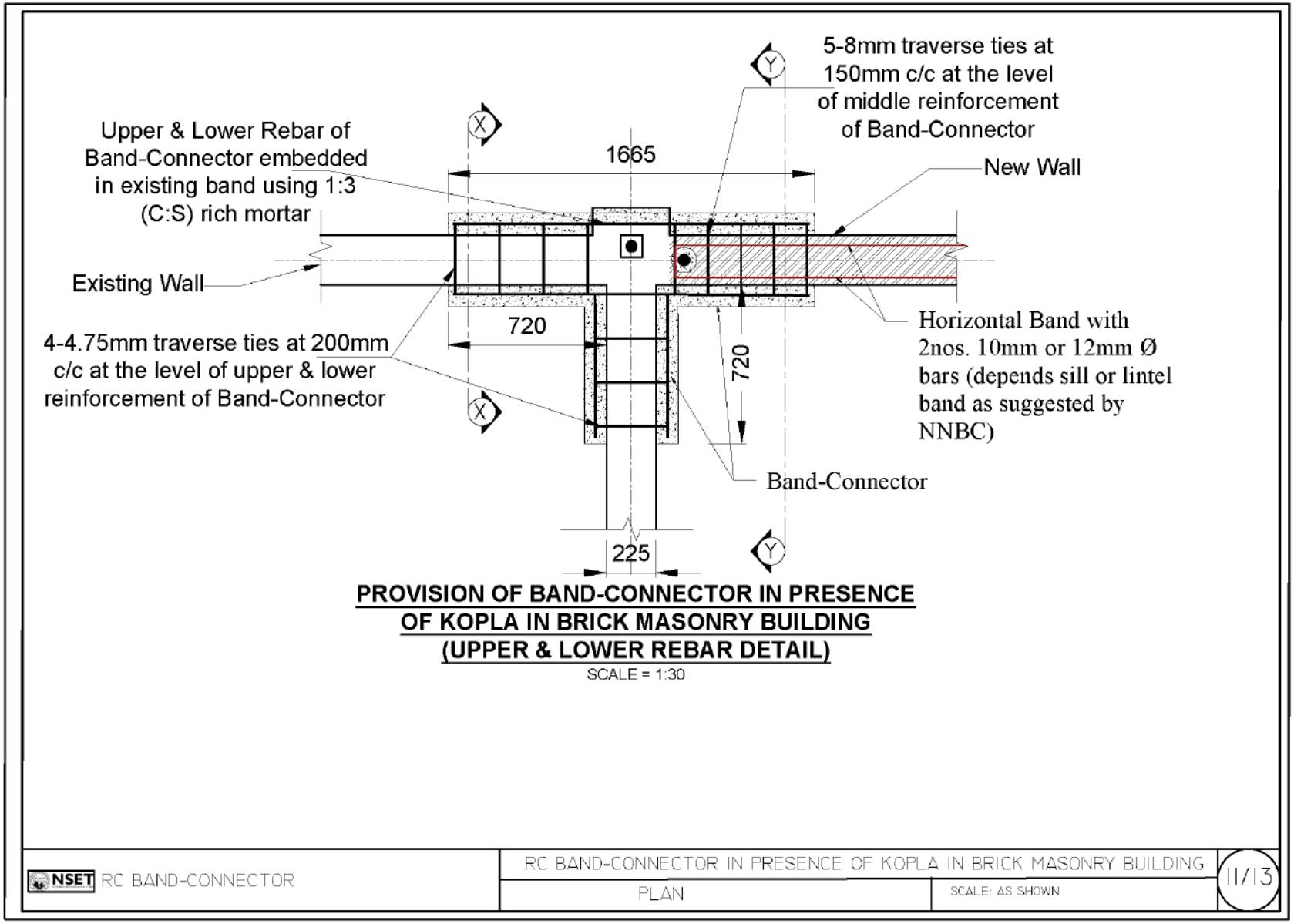


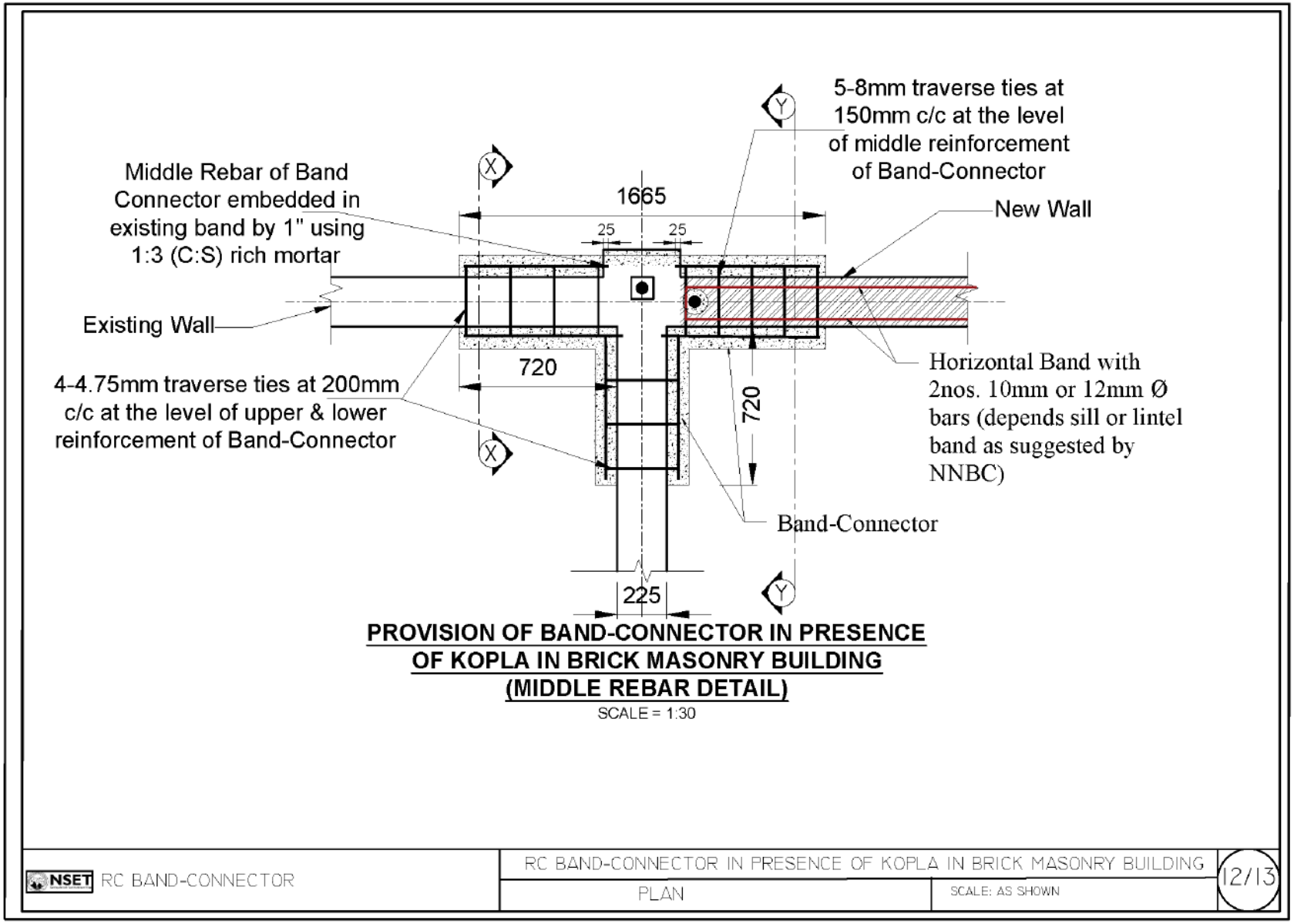
SECTION AT Y-Y
SCALE = 1:10

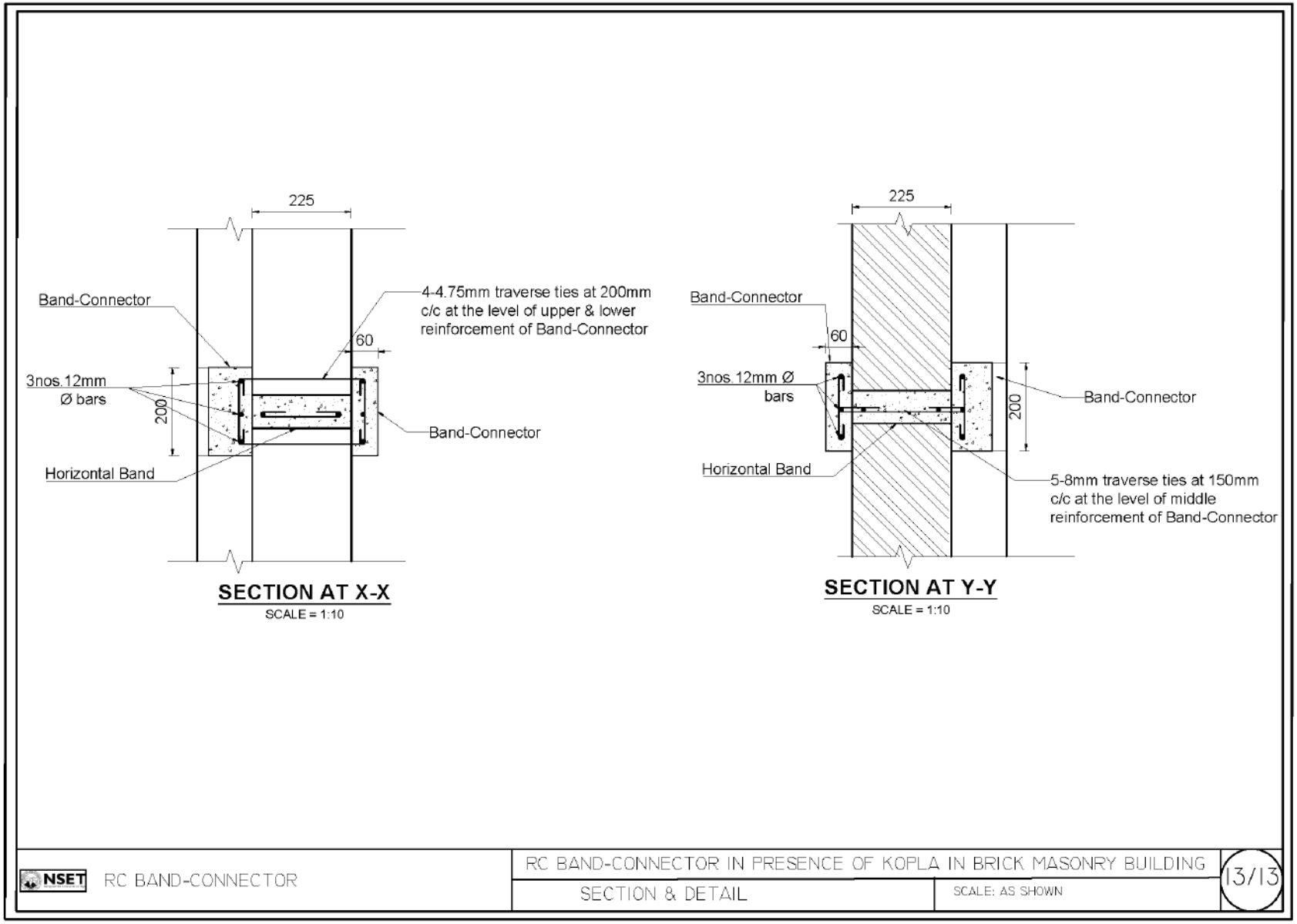


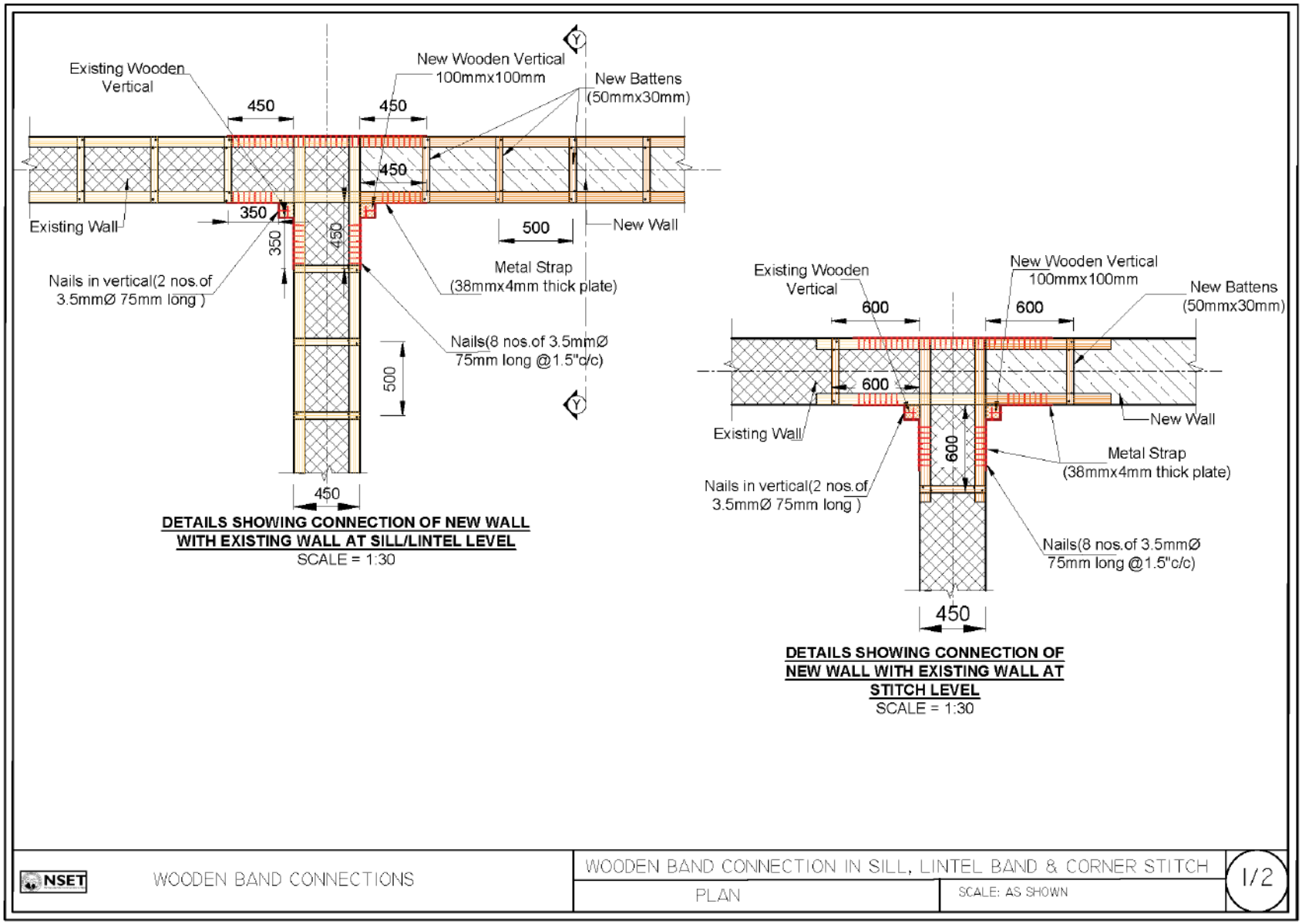
LAYOUT OF ANCHORAGE BARS PROVIDED TO CONNECT BAND-CONNECTOR WITH EXISTING WALL
(SCALE 1:20)

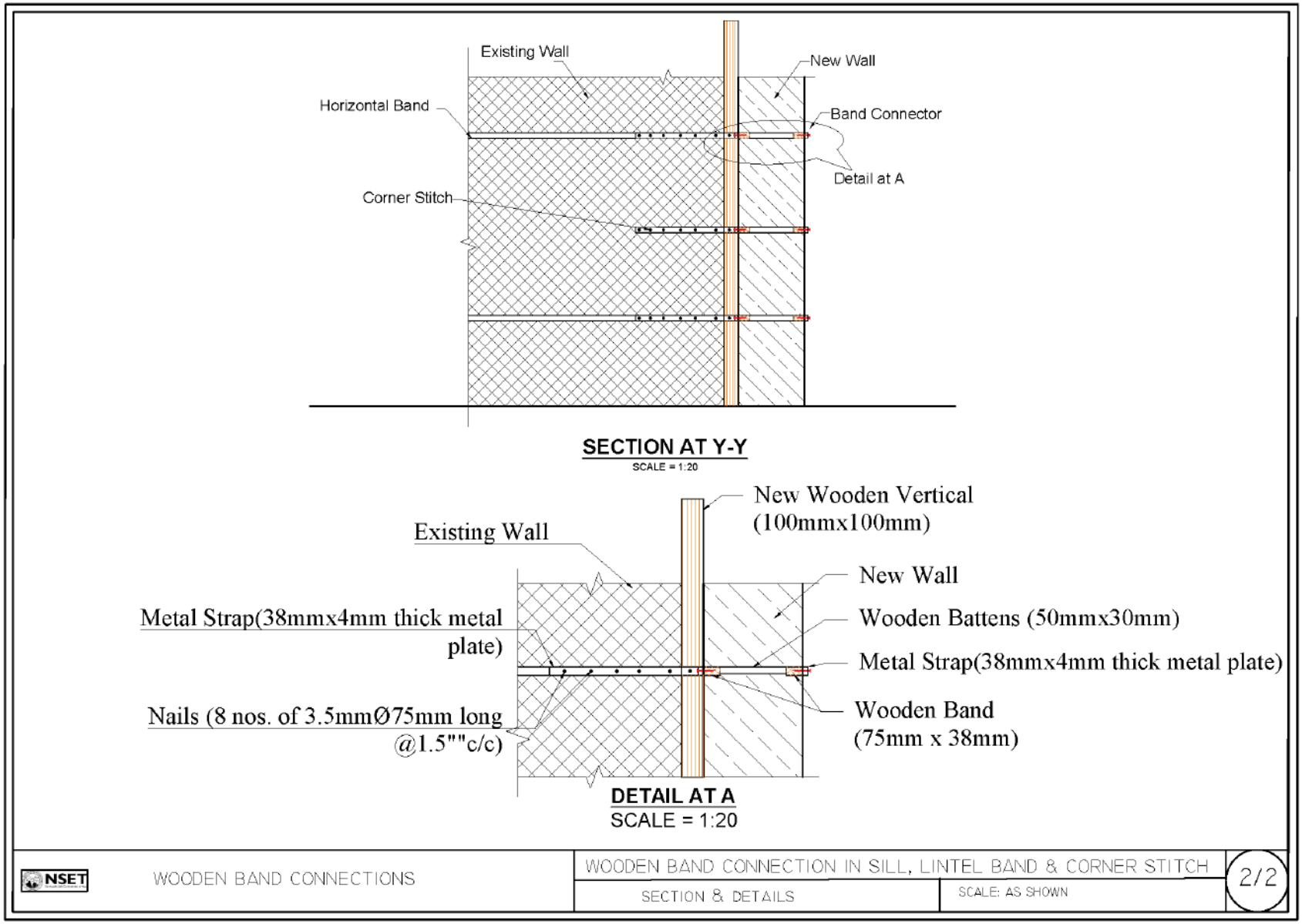
NSET RC BAND-CONNECTOR	RC BAND-CONNECTOR WITH 600MM LEG LENGTH IN THE TOPMOST BAND OF THE BUILDING SECTION & DETAIL	SCALE: AS SHOWN
		10/13

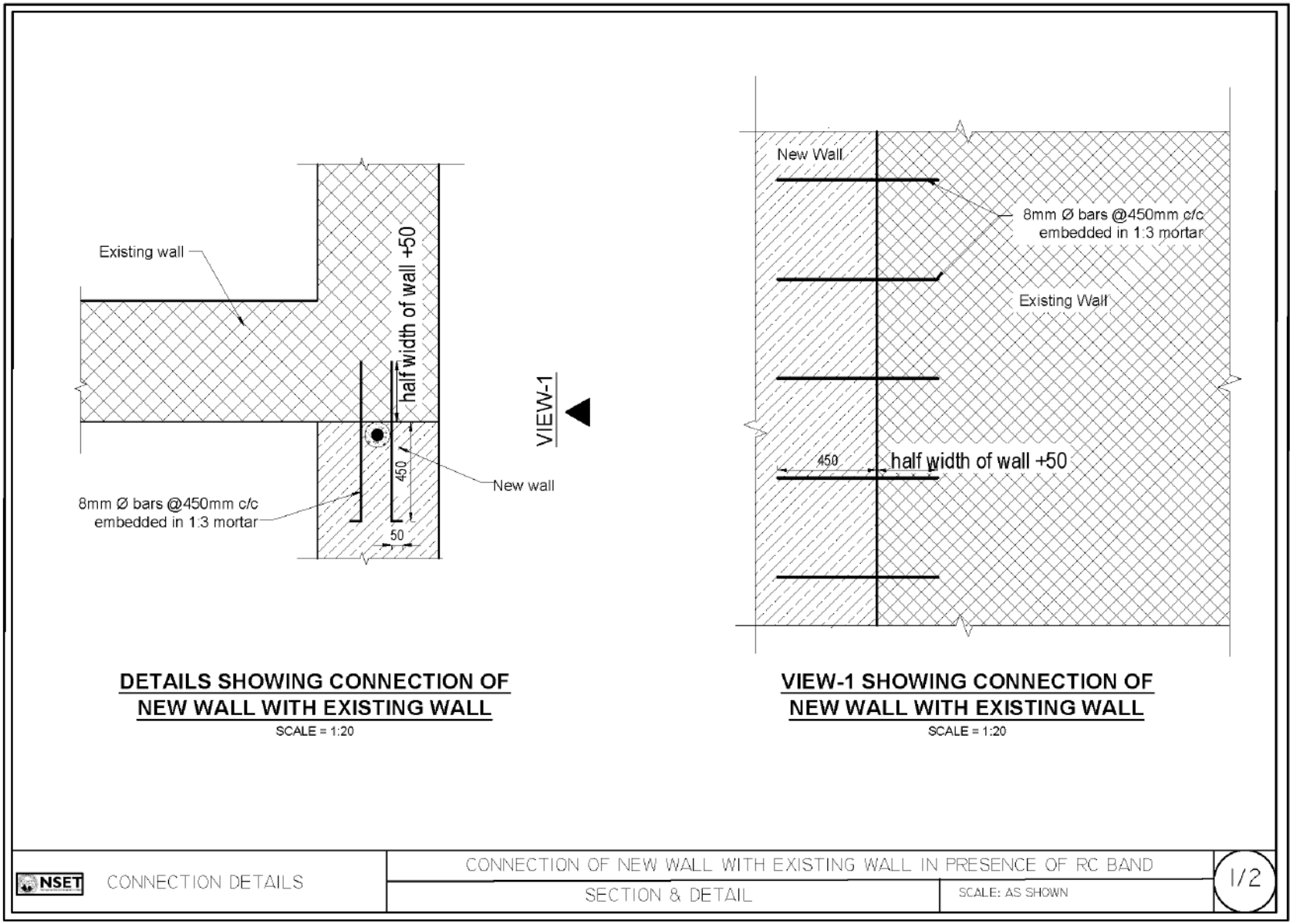

5-8mm traverse ties at
150mm c/c at the level
of middle reinforcement
of Band-Connector
Upper & Lower Rebar of
Band-Connector embedded
in existing band using 1:3
(C:S) rich mortar
1665
New Wall
Existing Wall
720
720
4-4.75mm traverse ties at 200mm
c/c at the level of upper & lower
reinforcement of Band-Connector
Horizontal Band with
2nos. 10mm or 12mm Ø
bars (depends sill or lintel
band as suggested by
NNBC)
Band-Connector
225
X
Y
PROVISION OF BAND-CONNECTOR IN PRESENCE
OF KOPLA IN BRICK MASONRY BUILDING
(UPPER & LOWER REBAR DETAIL)
SCALE = 1:30
NSET RC BAND-CONNECTOR
RC BAND-CONNECTOR IN PRESENCE OF KOPLA IN BRICK MASONRY BUILDING
PLAN
SCALE: AS SHOWN
11/13

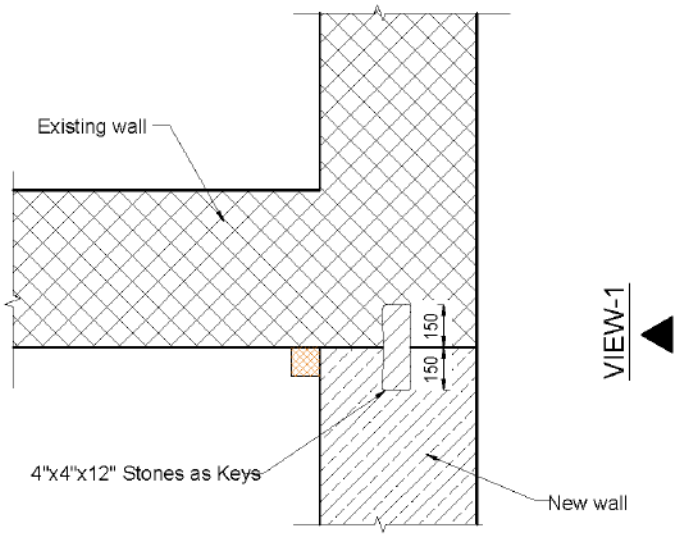

5-8mm traverse ties at 150mm c/c at the level of middle reinforcement of Band-Connector
Middle Rebar of Band Connector embedded in existing band by 1" using 1:3 (C:S) rich mortar
1665
25
25
New Wall
Existing Wall
720
720
4-4.75mm traverse ties at 200mm c/c at the level of upper & lower reinforcement of Band-Connector
Horizontal Band with 2nos. 10mm or 12mm Ø bars (depends sill or lintel band as suggested by NNBC)
Band-Connector
225
X
Y
PROVISION OF BAND-CONNECTOR IN PRESENCE OF KOPLA IN BRICK MASONRY BUILDING (MIDDLE REBAR DETAIL)
SCALE = 1:30
NSET RC BAND-CONNECTOR
RC BAND-CONNECTOR IN PRESENCE OF KOPLA IN BRICK MASONRY BUILDING
PLAN
SCALE: AS SHOWN
12/13


225
Band-Connector
4-4.75mm traverse ties at 200mm c/c at the level of upper & lower reinforcement of Band-Connector
60
3nos.12mm Ø bars
200
Band-Connector
Horizontal Band
SECTION AT X-X
SCALE = 1:10
225
Band-Connector
60
3nos.12mm Ø bars
200
Band-Connector
Horizontal Band
5-8mm traverse ties at 150mm c/c at the level of middle reinforcement of Band-Connector
SECTION AT Y-Y
SCALE = 1:10
NSET
RC BAND-CONNECTOR
RC BAND-CONNECTOR IN PRESENCE OF KOPLA IN BRICK MASONRY BUILDING
SECTION & DETAIL
SCALE: AS SHOWN
13/13

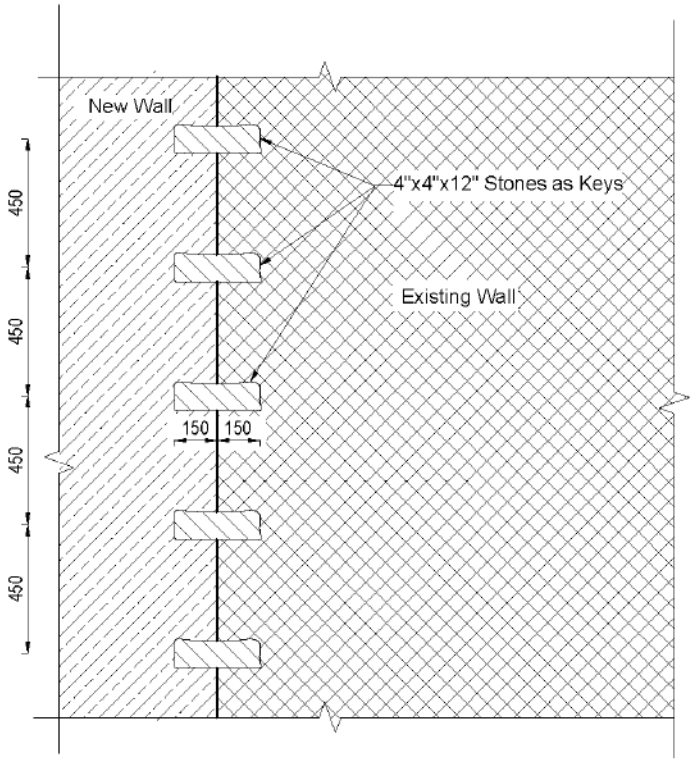

Existing Wooden Vertical
New Wooden Vertical 100mmx100mm
New Battens (50mmx30mm)
450
450
450
Existing Wall
350
350
450
500
New Wall
Metal Strap (38mmx4mm thick plate)
Nails in vertical(2 nos.of 3.5mmØ 75mm long)
Nails(8 nos.of 3.5mmØ 75mm long @1.5"c/c)
500
450
DETAILS SHOWING CONNECTION OF NEW WALL WITH EXISTING WALL AT SILL/LINTEL LEVEL
SCALE = 1:30
Existing Wooden Vertical
New Wooden Vertical 100mmx100mm
New Battens (50mmx30mm)
600
600
600
600
Existing Wall
New Wall
Metal Strap (38mmx4mm thick plate)
Nails in vertical(2 nos.of 3.5mmØ 75mm long)
Nails(8 nos.of 3.5mmØ 75mm long @1.5"c/c)
450
DETAILS SHOWING CONNECTION OF NEW WALL WITH EXISTING WALL AT STITCH LEVEL
SCALE = 1:30
NSET
WOODEN BAND CONNECTIONS
WOODEN BAND CONNECTION IN SILL, LINTEL BAND & CORNER STITCH
PLAN
SCALE: AS SHOWN
1/2


Existing Wall
New Wall
Horizontal Band
Band Connector
Detail at A
Corner Stitch
SECTION AT Y-Y
SCALE = 1:20
New Wooden Vertical
(100mmx100mm)
Existing Wall
New Wall
Metal Strap(38mmx4mm thick metal plate)
Wooden Battens (50mmx30mm)
Metal Strap(38mmx4mm thick metal plate)
Nails (8 nos. of 3.5mmØ75mm long @1.5""c/c)
Wooden Band
(75mm x 38mm)
DETAIL AT A
SCALE = 1:20
NSET
WOODEN BAND CONNECTIONS
WOODEN BAND CONNECTION IN SILL, LINTEL BAND & CORNER STITCH
SECTION & DETAILS
SCALE: AS SHOWN
2/2


Existing wall
half width of wall +50
VIEW-1
New wall
8mm Ø bars @450mm c/c
embedded in 1:3 mortar
450
50
New Wall
8mm Ø bars @450mm c/c
embedded in 1:3 mortar
Existing Wall
450
half width of wall +50
DETAILS SHOWING CONNECTION OF
NEW WALL WITH EXISTING WALL
SCALE = 1:20
VIEW-1 SHOWING CONNECTION OF
NEW WALL WITH EXISTING WALL
SCALE = 1:20
NSET
CONNECTION DETAILS
CONNECTION OF NEW WALL WITH EXISTING WALL IN PRESENCE OF RC BAND
SECTION & DETAIL
SCALE: AS SHOWN
1/2

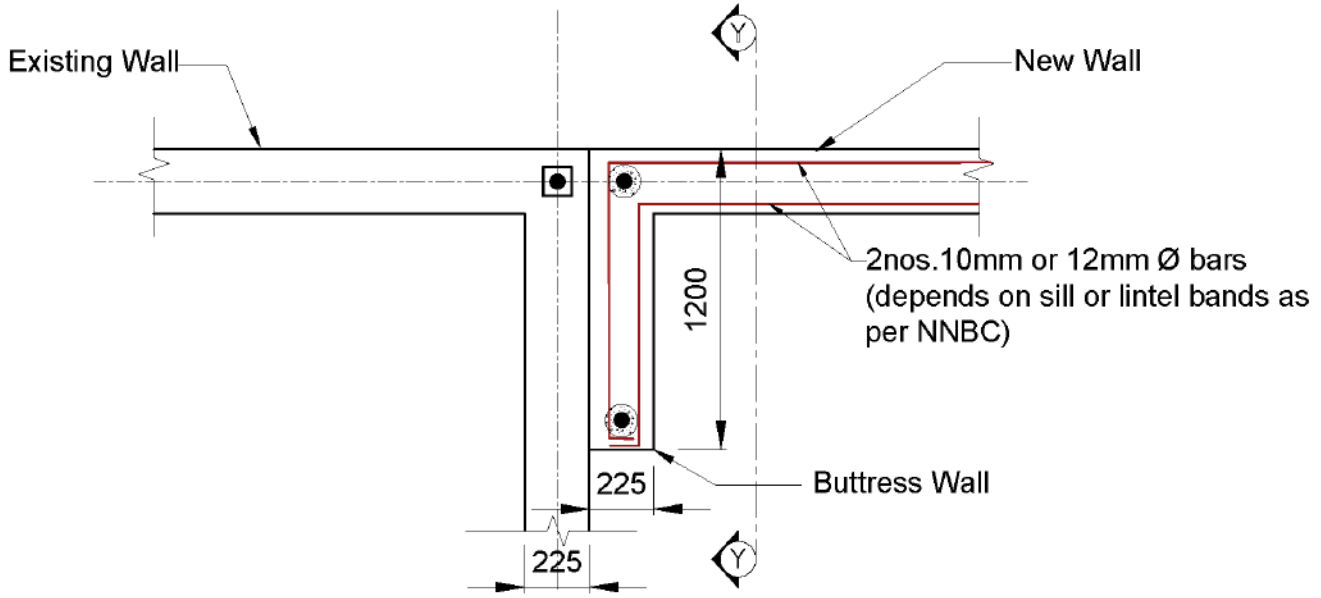


DETAILS SHOWING CONNECTION OF NEW WALL WITH EXISTING WALL (PLAN)
SCALE = 1:20



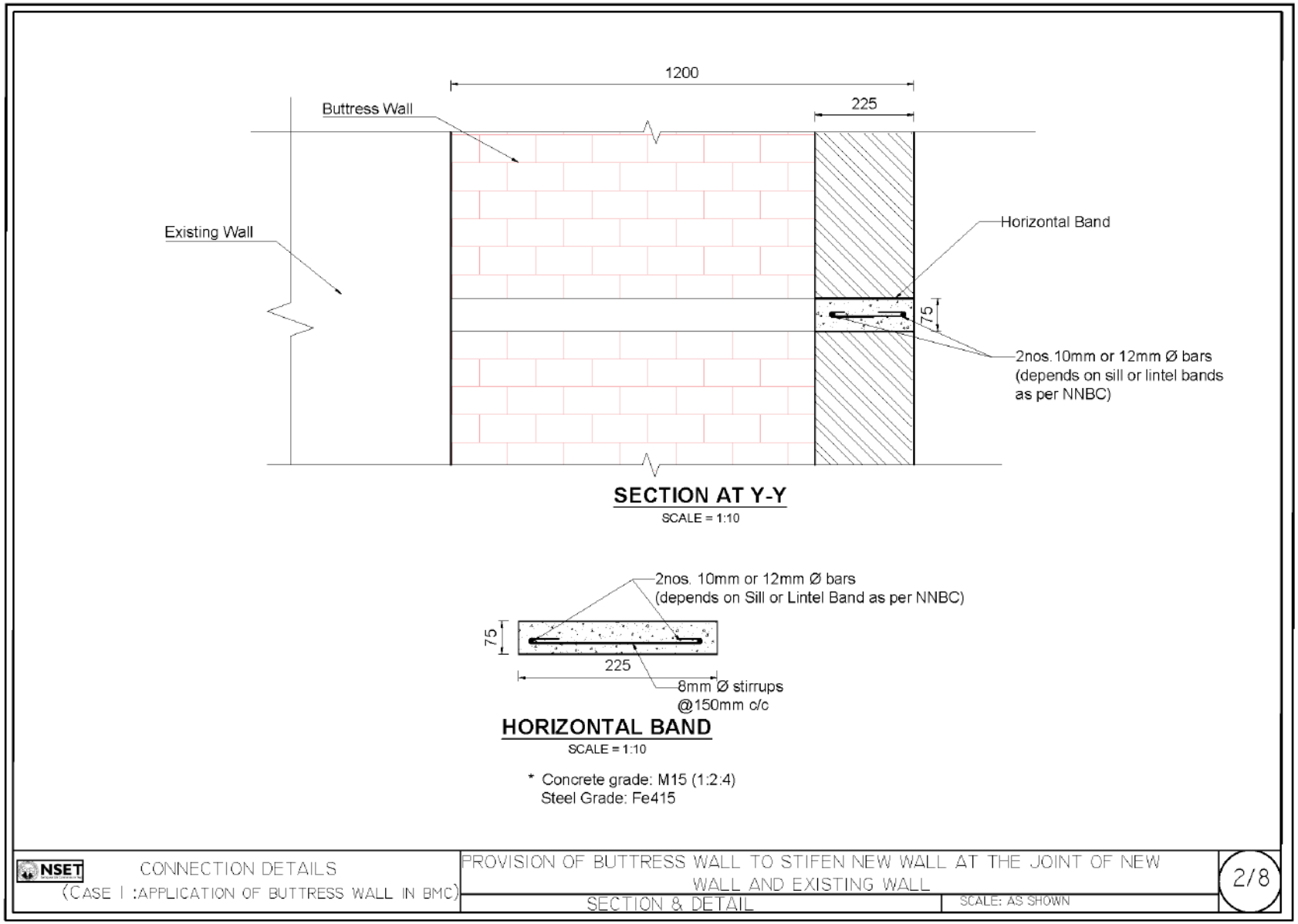
VIEW-1 SHOWING CONNECTION OF NEW WALL WITH EXISTING WALL (ELEVATION)
SCALE = 1:20

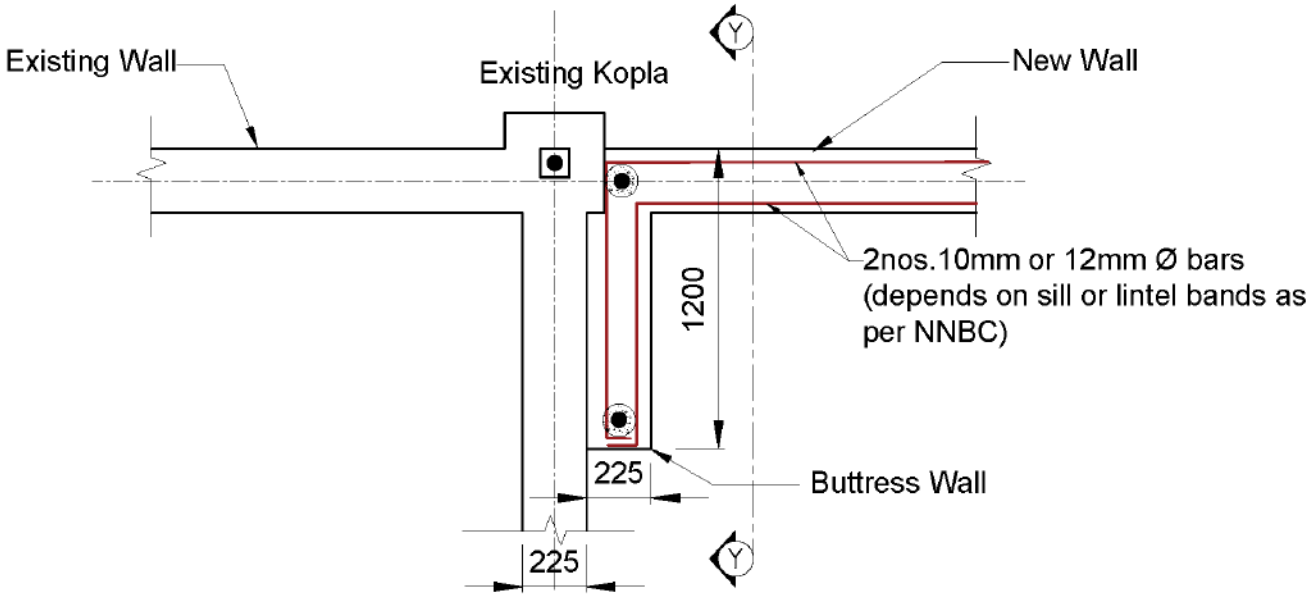
NSET CONNECTION DETAILS	CONNECTION OF NEW WALL WITH EXISTING WALL IN PRESENCE OF WOODEN BAND	2/2
	SECTION & DETAIL — SCALE: AS SHOWN	



PROVISION OF BUTTRESS WALL TO STIFFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL
SCALE = 1:20

NSET CONNECTION DETAILS (CASE I :APPLICATION OF BUTTRESS WALL IN BMC)	PROVISION OF BUTTRESS WALL TO STIFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL SECTION & DETAIL — SCALE: AS SHOWN	1/8

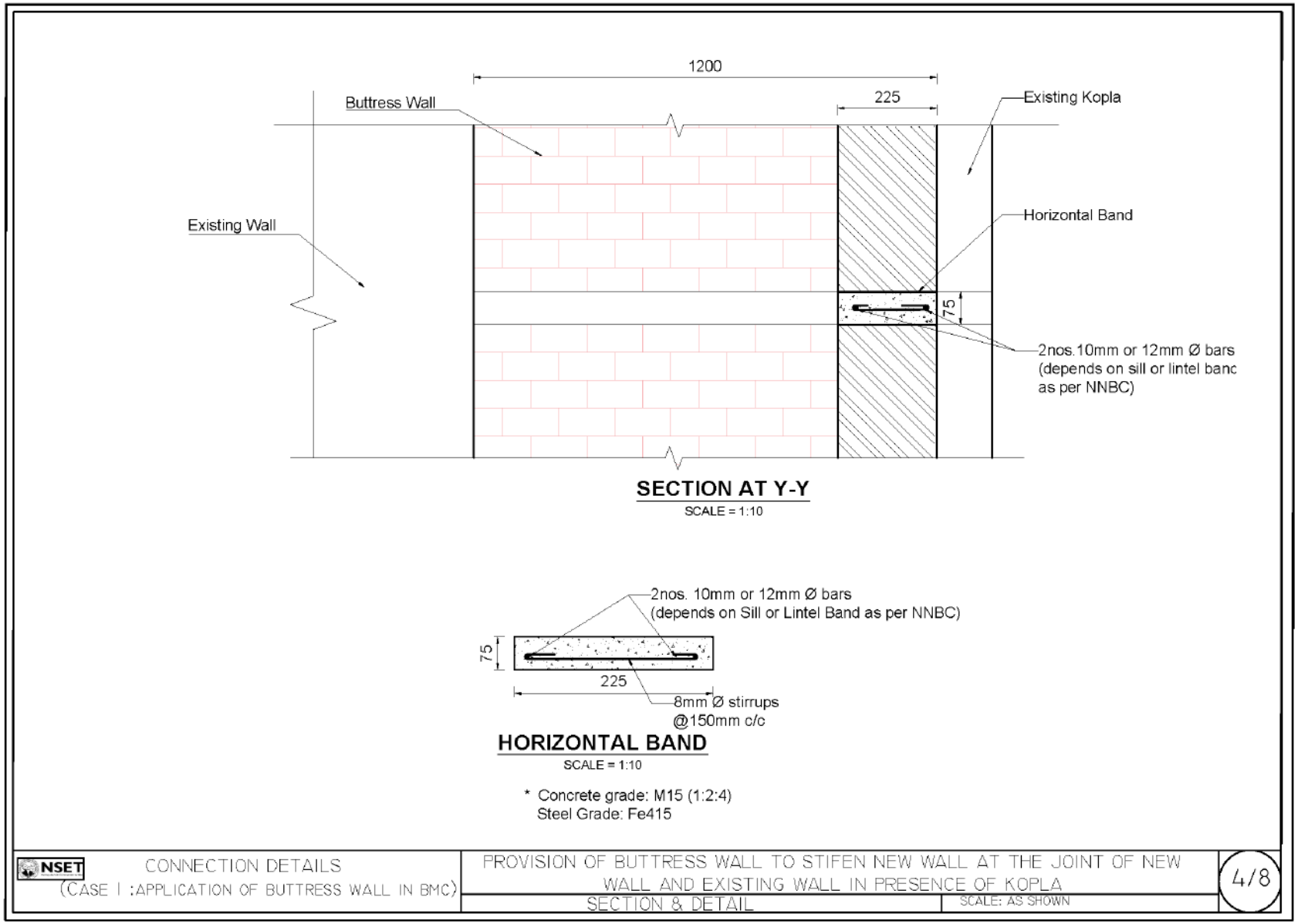

1200
225
Buttress Wall
Existing Wall
Horizontal Band
75
2nos.10mm or 12mm Ø bars
(depends on sill or lintel bands
as per NNBC)
SECTION AT Y-Y
SCALE = 1:10
2nos. 10mm or 12mm Ø bars
(depends on Sill or Lintel Band as per NNBC)
75
225
8mm Ø stirrups
@150mm c/c
HORIZONTAL BAND
SCALE = 1:10
* Concrete grade: M15 (1:2:4)
Steel Grade: Fe415
NSET
CONNECTION DETAILS
(CASE I :APPLICATION OF BUTTRESS WALL IN BMC)
PROVISION OF BUTTRESS WALL TO STIFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL
SECTION & DETAIL
SCALE: AS SHOWN
2/8

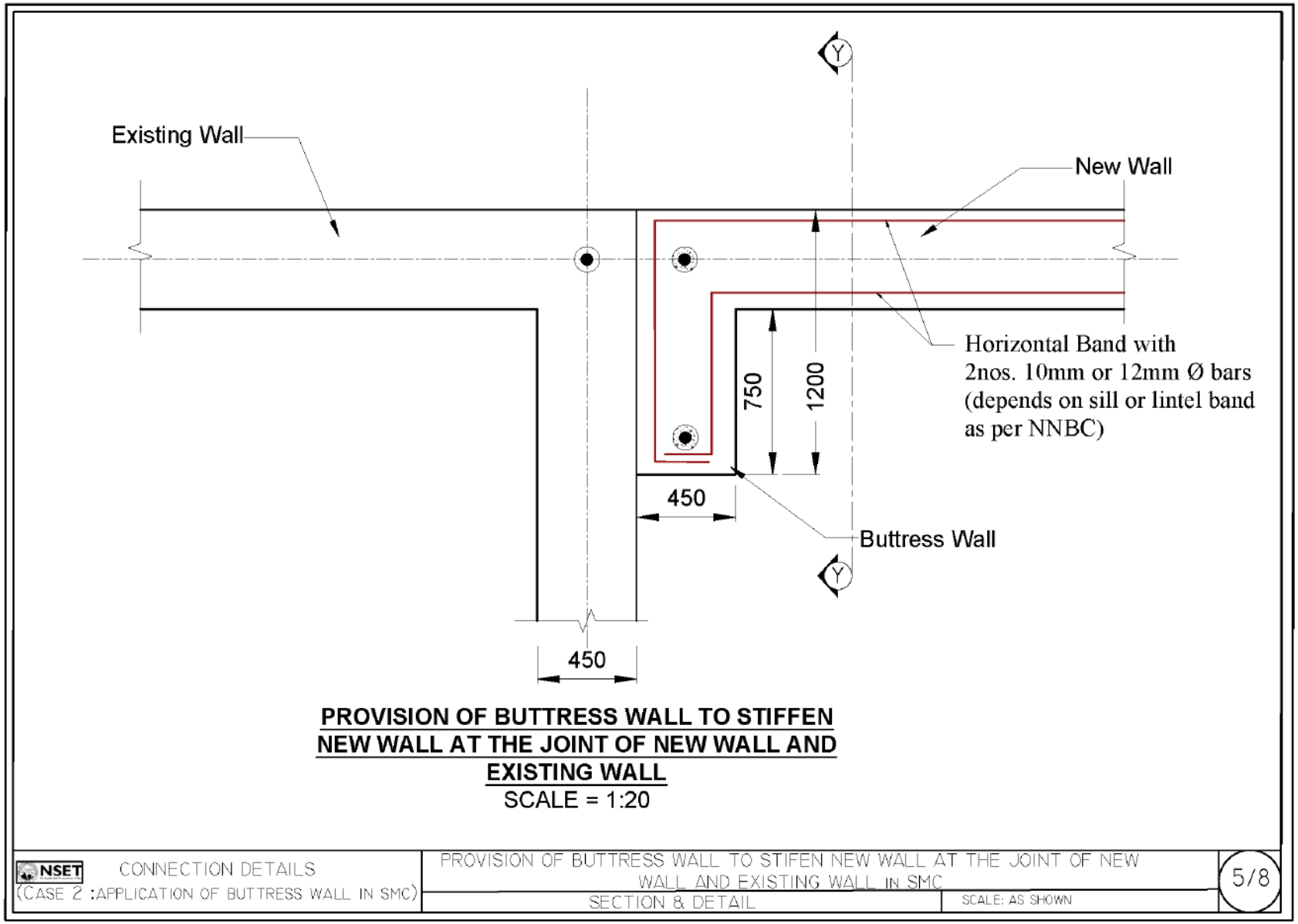


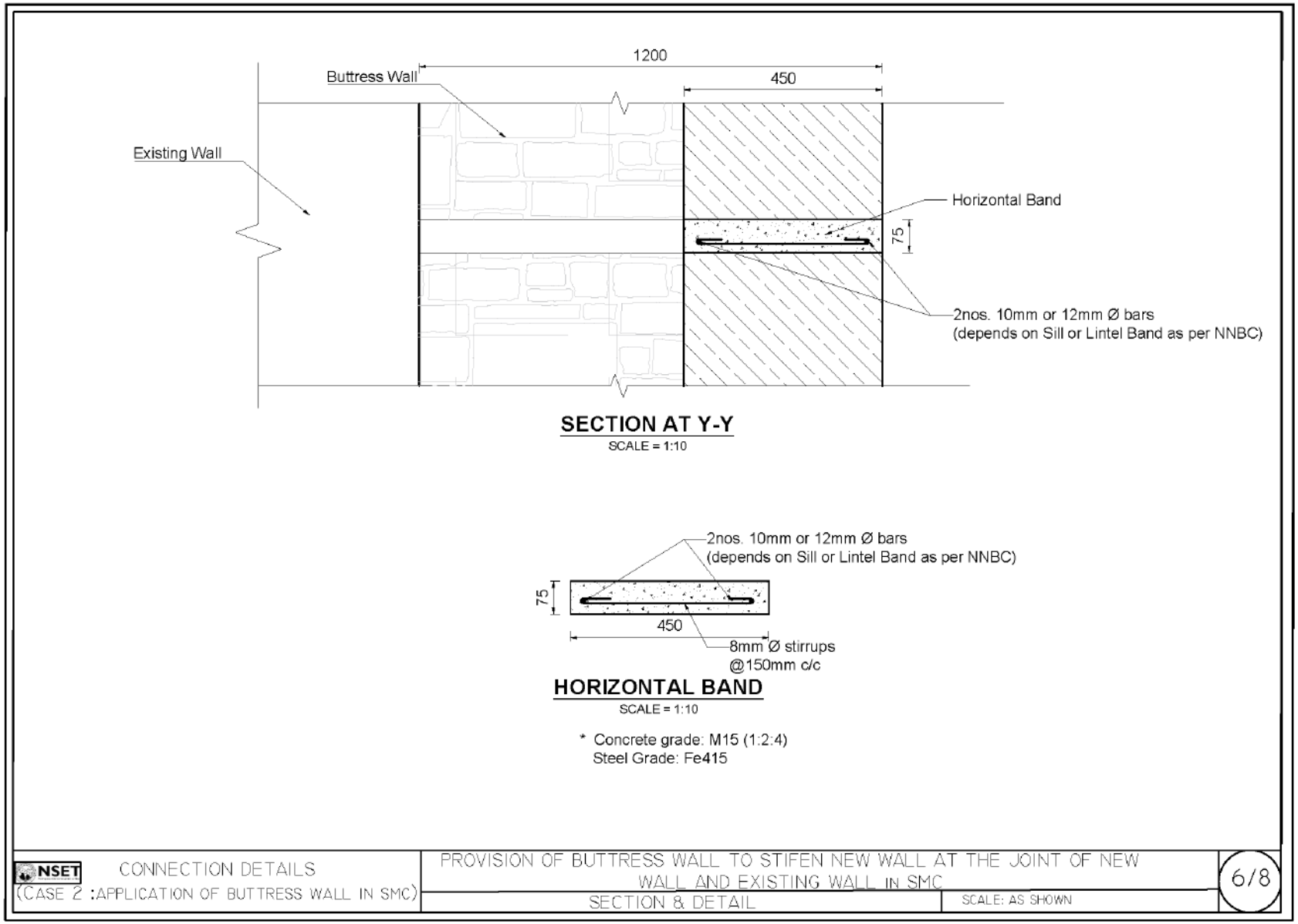
PROVISION OF BUTTRESS WALL TO STIFFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL IN PRESENCE OF KOPLA

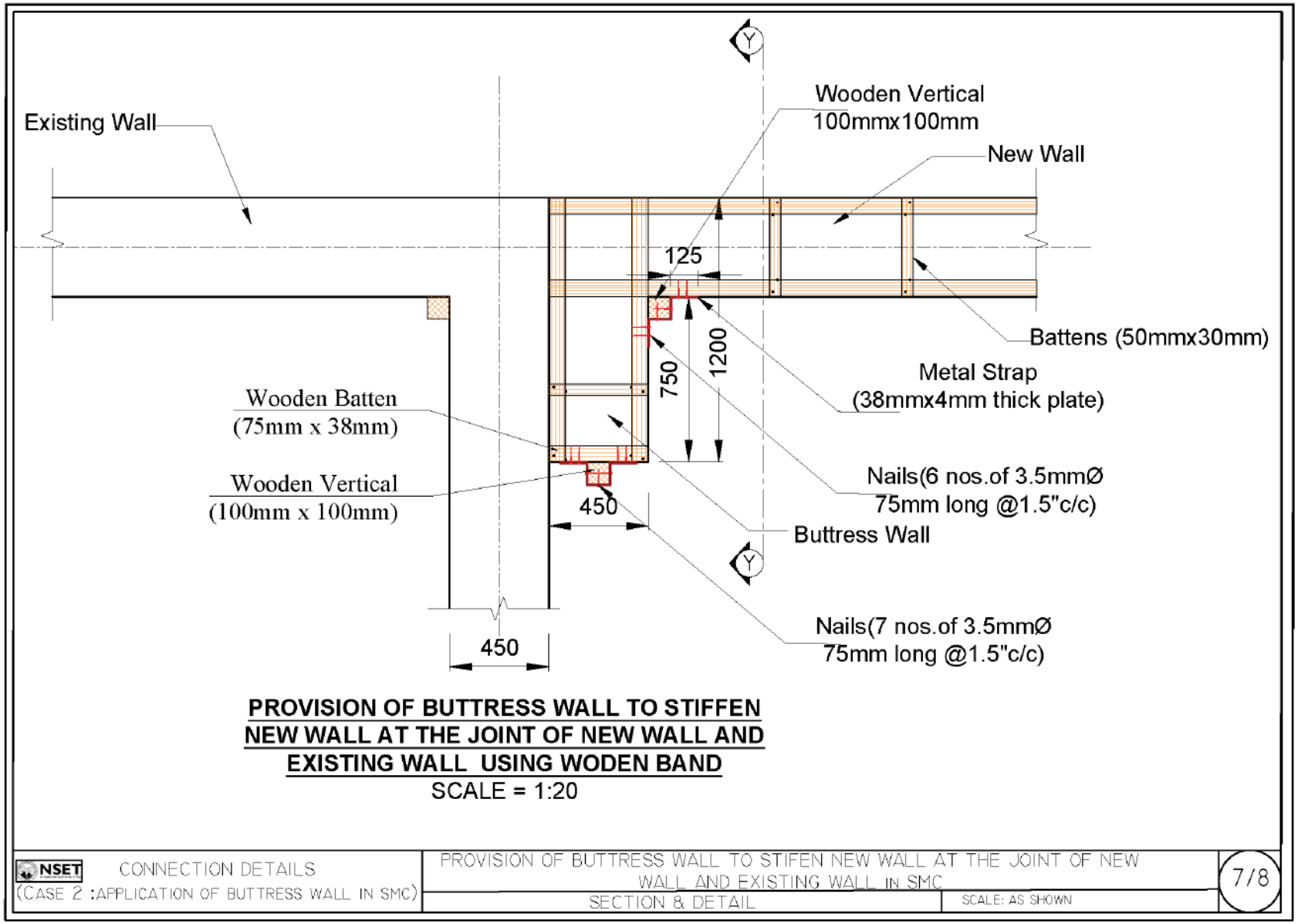
SCALE = 1:20

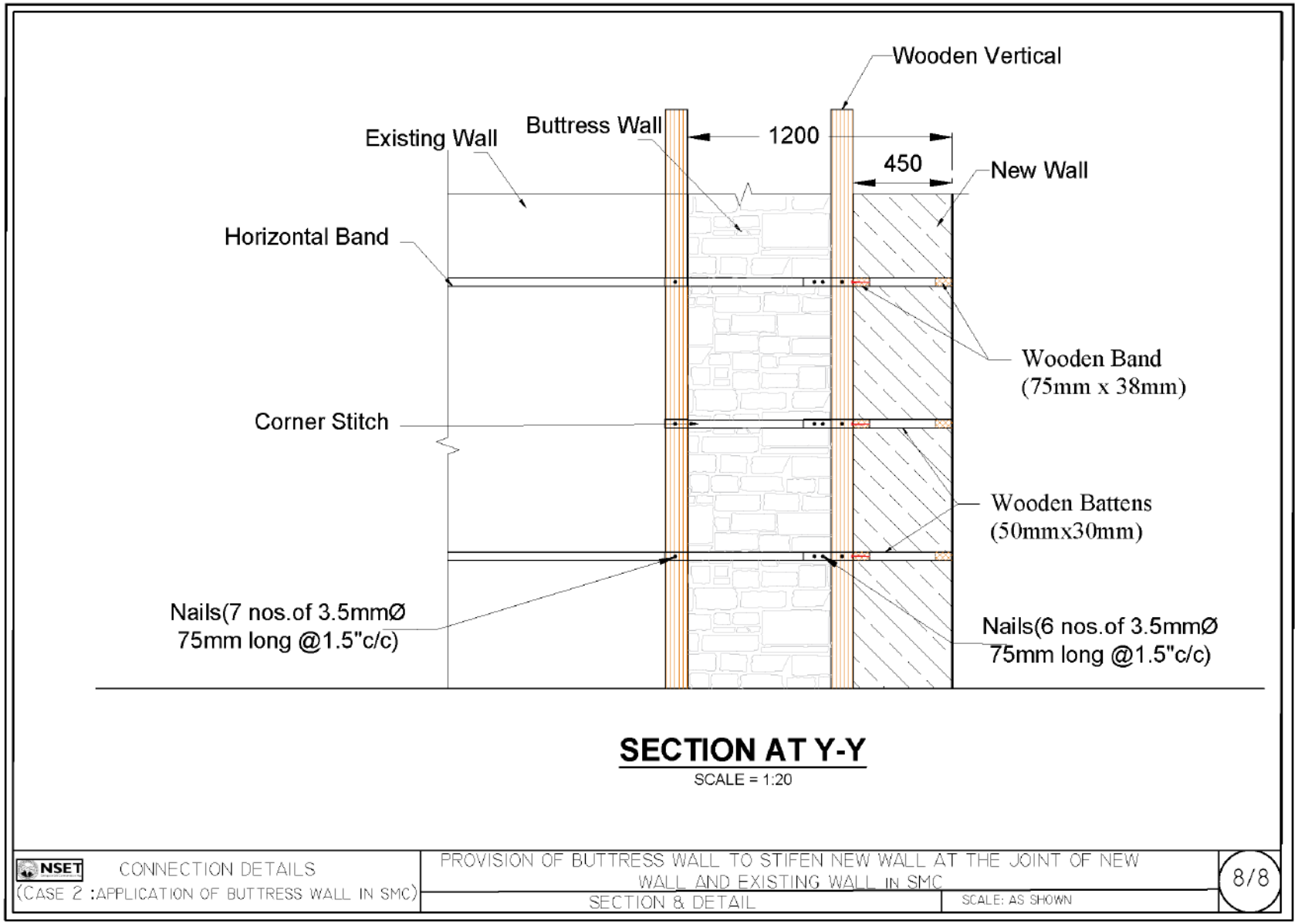
NSET CONNECTION DETAILS (CASE I :APPLICATION OF BUTTRESS WALL IN BMC)	PROVISION OF BUTTRESS WALL TO STIFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL IN PRESENCE OF KOPLA SECTION & DETAIL — SCALE: AS SHOWN	3/8

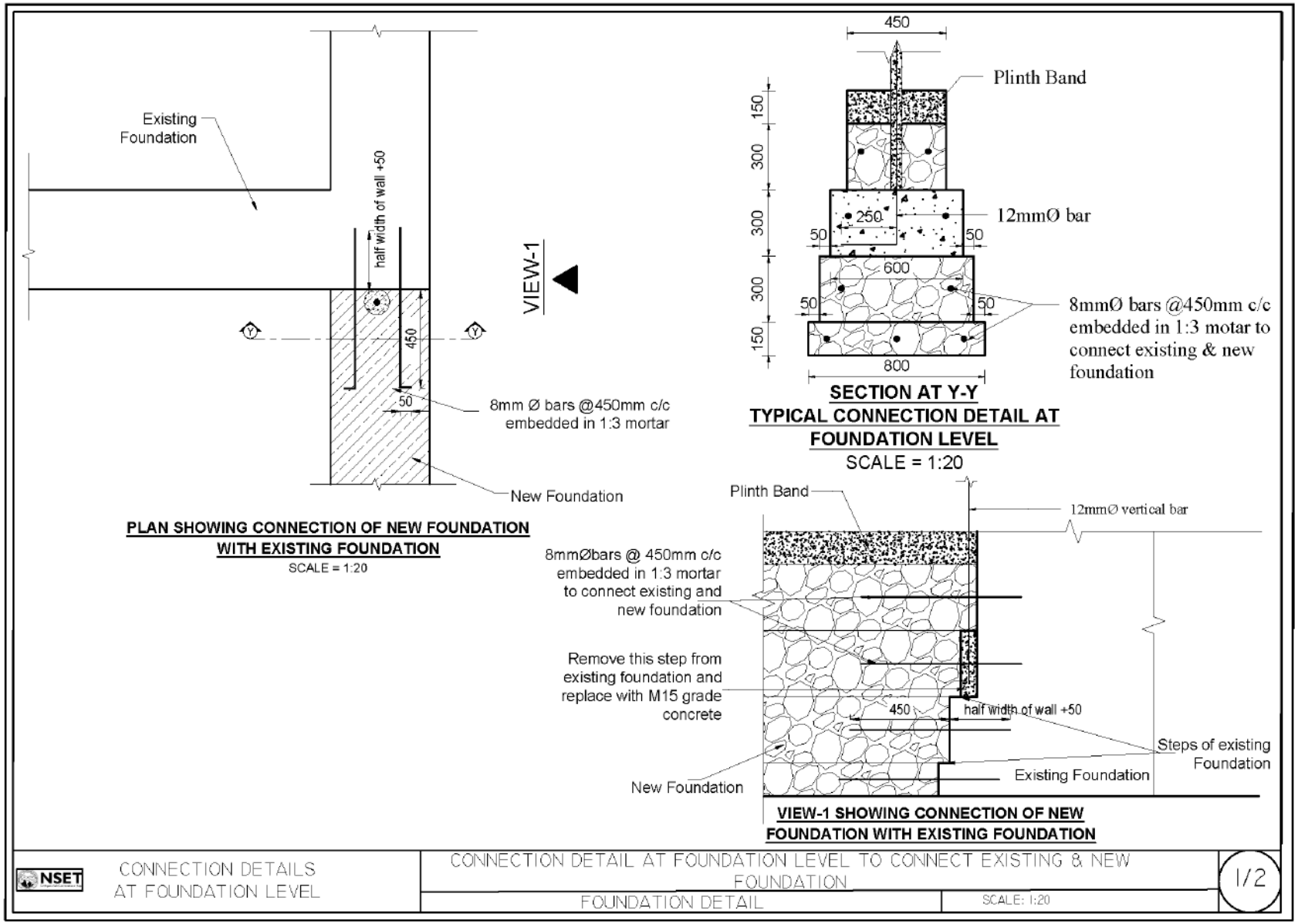

1200
225
Buttress Wall
Existing Kopla
Existing Wall
Horizontal Band
75
2nos.10mm or 12mm Ø bars
(depends on sill or lintel banc
as per NNBC)
SECTION AT Y-Y
SCALE = 1:10
2nos. 10mm or 12mm Ø bars
(depends on Sill or Lintel Band as per NNBC)
75
225
8mm Ø stirrups
@150mm c/c
HORIZONTAL BAND
SCALE = 1:10
* Concrete grade: M15 (1:2:4)
Steel Grade: Fe415
NSET
CONNECTION DETAILS
(CASE I :APPLICATION OF BUTTRESS WALL IN BMC)
PROVISION OF BUTTRESS WALL TO STIFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL IN PRESENCE OF KOPLA
SECTION & DETAIL
SCALE: AS SHOWN
4/8

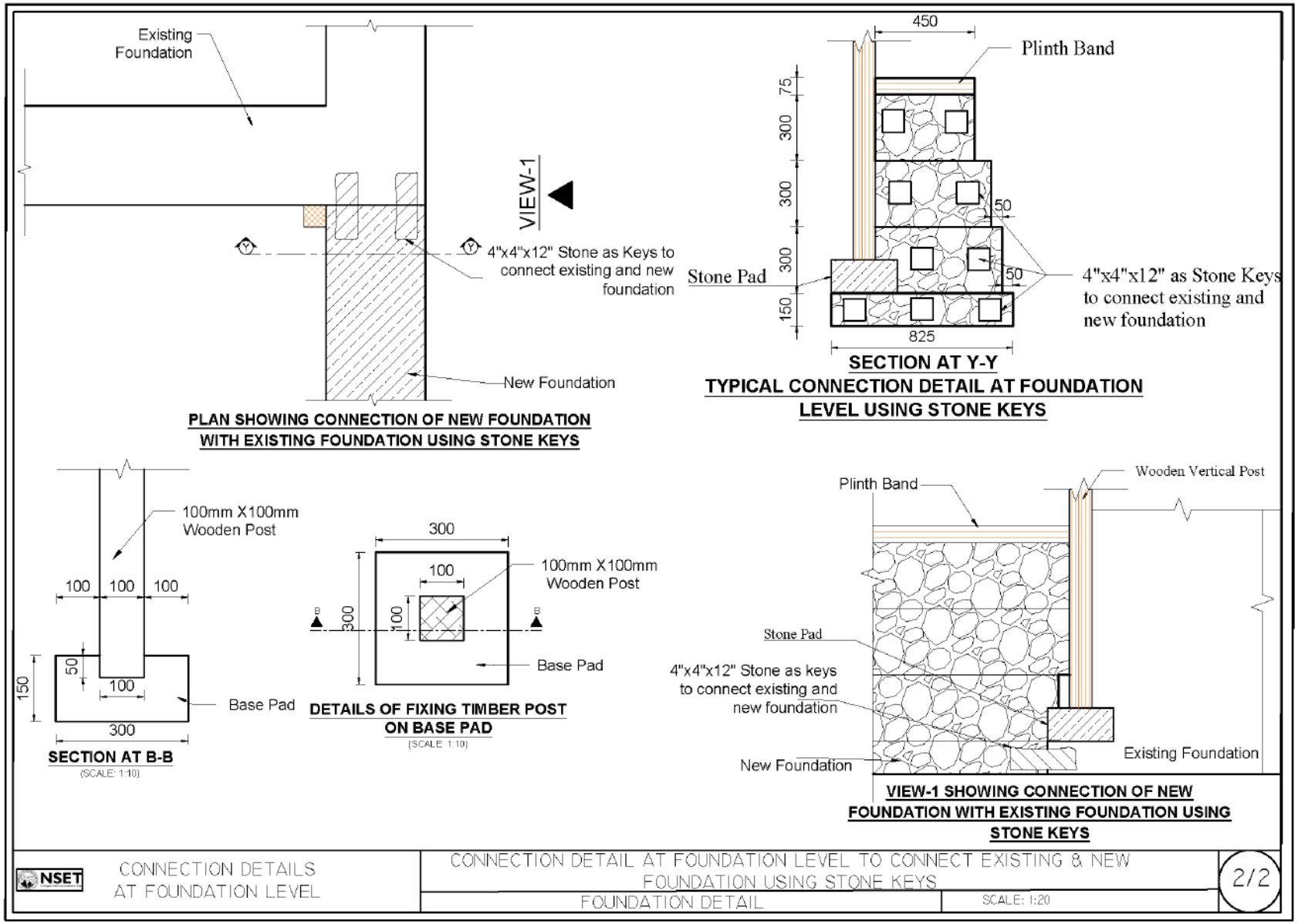

Y
Existing Wall
New Wall
Horizontal Band with
2nos. 10mm or 12mm Ø bars
(depends on sill or lintel band
as per NNBC)
750
1200
450
Buttress Wall
Y
450
PROVISION OF BUTTRESS WALL TO STIFFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL
SCALE = 1:20
NSET
CONNECTION DETAILS
(CASE 2 :APPLICATION OF BUTTRESS WALL IN SMC)
PROVISION OF BUTTRESS WALL TO STIFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL IN SMC
SECTION & DETAIL
SCALE: AS SHOWN
5/8

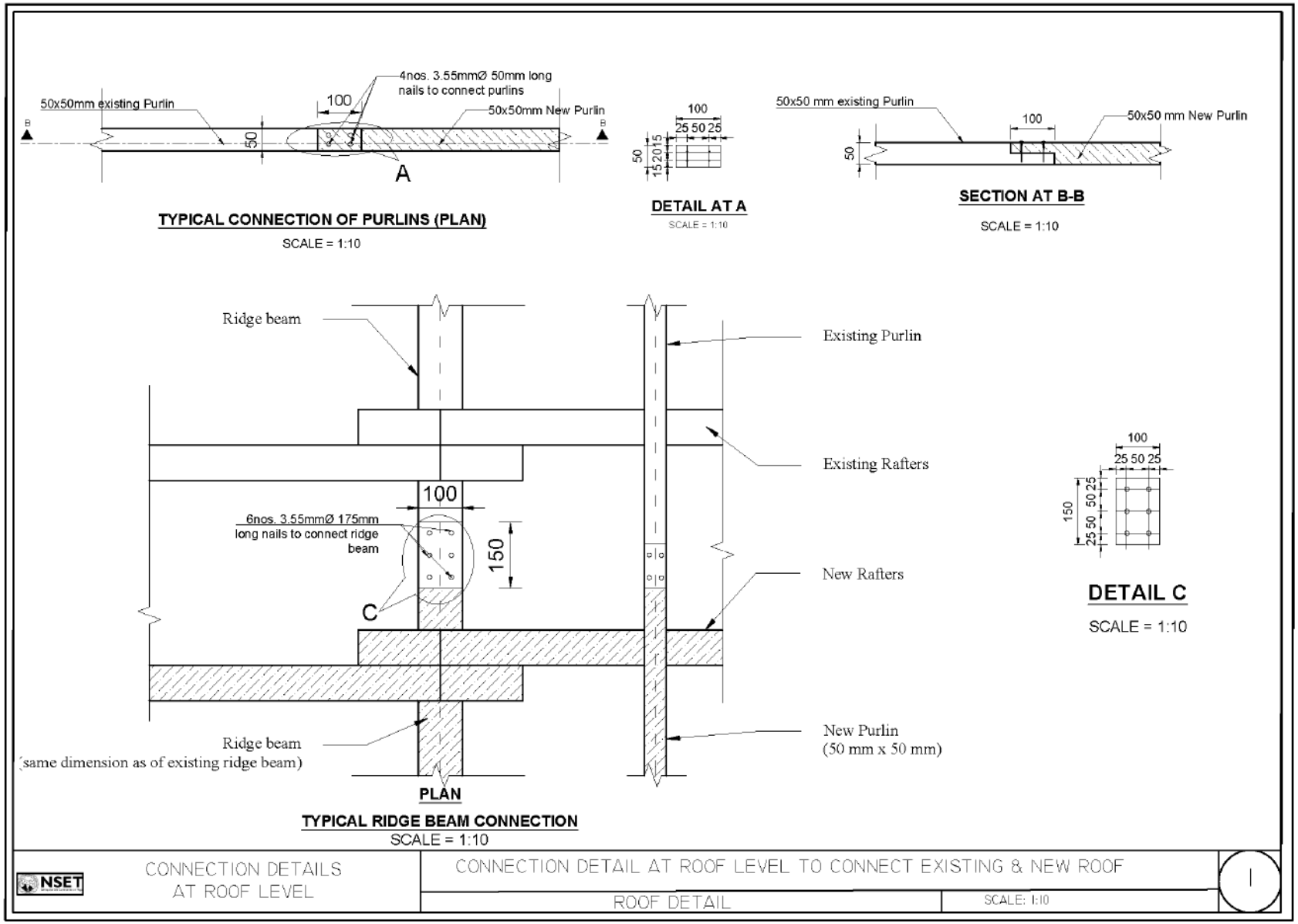

1200
Buttress Wall
450
Existing Wall
Horizontal Band
75
2nos. 10mm or 12mm Ø bars
(depends on Sill or Lintel Band as per NNBC)
SECTION AT Y-Y
SCALE = 1:10
2nos. 10mm or 12mm Ø bars
(depends on Sill or Lintel Band as per NNBC)
75
450
8mm Ø stirrups
@150mm c/c
HORIZONTAL BAND
SCALE = 1:10
* Concrete grade: M15 (1:2:4)
Steel Grade: Fe415
NSET
CONNECTION DETAILS
(CASE 2 :APPLICATION OF BUTTRESS WALL IN SMC)
PROVISION OF BUTTRESS WALL TO STIFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL IN SMC
SECTION & DETAIL
SCALE: AS SHOWN
6/8


Y
Existing Wall
Wooden Vertical
100mmx100mm
New Wall
125
Battens (50mmx30mm)
1200
750
Metal Strap
(38mmx4mm thick plate)
Wooden Batten
(75mm x 38mm)
Wooden Vertical
(100mm x 100mm)
Nails(6 nos.of 3.5mmØ
75mm long @1.5"c/c)
450
Buttress Wall
Y
Nails(7 nos.of 3.5mmØ
75mm long @1.5"c/c)
450
PROVISION OF BUTTRESS WALL TO STIFFEN
NEW WALL AT THE JOINT OF NEW WALL AND
EXISTING WALL USING WODEN BAND
SCALE = 1:20
NSET
CONNECTION DETAILS
(CASE 2 :APPLICATION OF BUTTRESS WALL IN SMC)
PROVISION OF BUTTRESS WALL TO STIFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL IN SMC
SECTION & DETAIL
SCALE: AS SHOWN
7/8


Wooden Vertical
Existing Wall
Buttress Wall
1200
450
New Wall
Horizontal Band
Wooden Band
(75mm x 38mm)
Corner Stitch
Wooden Battens
(50mmx30mm)
Nails(7 nos.of 3.5mmØ
75mm long @1.5"c/c)
Nails(6 nos.of 3.5mmØ
75mm long @1.5"c/c)
SECTION AT Y-Y
SCALE = 1:20
NSET
CONNECTION DETAILS
(CASE 2 :APPLICATION OF BUTTRESS WALL IN SMC)
PROVISION OF BUTTRESS WALL TO STIFEN NEW WALL AT THE JOINT OF NEW WALL AND EXISTING WALL IN SMC
SECTION & DETAIL
SCALE: AS SHOWN
8/8


Existing Foundation
half width of wall +50
VIEW-1
450
50
8mm Ø bars @450mm c/c embedded in 1:3 mortar
New Foundation
PLAN SHOWING CONNECTION OF NEW FOUNDATION WITH EXISTING FOUNDATION
SCALE = 1:20
450
Plinth Band
150
300
300
300
150
250
12mmØ bar
50
50
600
50
50
800
8mmØ bars @450mm c/c embedded in 1:3 motar to connect existing & new foundation
SECTION AT Y-Y
TYPICAL CONNECTION DETAIL AT FOUNDATION LEVEL
SCALE = 1:20
Plinth Band
12mmØ vertical bar
8mmØbars @ 450mm c/c embedded in 1:3 mortar to connect existing and new foundation
Remove this step from existing foundation and replace with M15 grade concrete
450
half width of wall +50
Steps of existing Foundation
Existing Foundation
New Foundation
VIEW-1 SHOWING CONNECTION OF NEW FOUNDATION WITH EXISTING FOUNDATION
NSET
CONNECTION DETAILS AT FOUNDATION LEVEL
CONNECTION DETAIL AT FOUNDATION LEVEL TO CONNECT EXISTING & NEW FOUNDATION
FOUNDATION DETAIL
SCALE: 1:20
1/2


Existing Foundation
VIEW-1
4"x4"x12" Stone as Keys to connect existing and new foundation
New Foundation
PLAN SHOWING CONNECTION OF NEW FOUNDATION WITH EXISTING FOUNDATION USING STONE KEYS
450
Plinth Band
75
300
300
300
150
50
50
Stone Pad
4"x4"x12" as Stone Keys to connect existing and new foundation
825
SECTION AT Y-Y
TYPICAL CONNECTION DETAIL AT FOUNDATION LEVEL USING STONE KEYS
100mm X100mm Wooden Post
100
100
100
50
100
150
Base Pad
300
SECTION AT B-B
(SCALE: 1:10)
300
100
100mm X100mm Wooden Post
300
100
Base Pad
DETAILS OF FIXING TIMBER POST ON BASE PAD
(SCALE 1:10)
Plinth Band
Wooden Vertical Post
Stone Pad
4"x4"x12" Stone as keys to connect existing and new foundation
New Foundation
Existing Foundation
VIEW-1 SHOWING CONNECTION OF NEW FOUNDATION WITH EXISTING FOUNDATION USING STONE KEYS
NSET
CONNECTION DETAILS AT FOUNDATION LEVEL
CONNECTION DETAIL AT FOUNDATION LEVEL TO CONNECT EXISTING & NEW FOUNDATION USING STONE KEYS
FOUNDATION DETAIL
SCALE: 1:20
2/2


50x50mm existing Purlin
100
4nos. 3.55mmØ 50mm long nails to connect purlins
50x50mm New Purlin
50
A
TYPICAL CONNECTION OF PURLINS (PLAN)
SCALE = 1:10
100
25 50 25
50
15 20 15
DETAIL AT A
SCALE = 1:10
50x50 mm existing Purlin
100
50x50 mm New Purlin
50
SECTION AT B-B
SCALE = 1:10
Ridge beam
Existing Purlin
Existing Rafters
100
6nos. 3.55mmØ 175mm long nails to connect ridge beam
150
C
New Rafters
Ridge beam
(same dimension as of existing ridge beam)
New Purlin
(50 mm x 50 mm)
PLAN
TYPICAL RIDGE BEAM CONNECTION
SCALE = 1:10
100
25 50 25
150
25 50 50 25
DETAIL C
SCALE = 1:10
NSET
CONNECTION DETAILS AT ROOF LEVEL
CONNECTION DETAIL AT ROOF LEVEL TO CONNECT EXISTING & NEW ROOF
ROOF DETAIL
SCALE: 1:10
1

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