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DESIGN & CONSTRUCTION OF REINFORCED SOIL WALL BY USING PRE-CASTED PANELS

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Abstract

Reinforced earth may be a material shaped by combining earth and reinforcement material. The reinforced soil is obtained by putting extensile or non-extensile materials like gold strips or compound reinforcement at intervals the soil to get the requisite properties. The reinforcement allows the soil mass to resist tension during a manner that the planet alone couldn't. The supply of this resistance to tension is that the internal friction of soil, as a result of the stresses that created at intervals the mass transferred from soil to the reinforcement strips by friction. Reinforcement of soil is practiced to enhance the mechanical properties of the soil being reinforced by the inclusion of structural components. The reinforcement improves the earth by increasing the bearing capability of the soil. It additionally reduces the physical change behavior of the soil. reinforced earth isn't complicated to realize. The parts of reinforced earth are soil, skin and reinforcing material. The reinforcing material could embrace steel, concrete, glass, planks etc. reinforced earth has such a large amount of applications in construction work. a number of the applications embrace its use in stabilization of soil, construction of retentive walls, bridge abutments for highways, industrial and mining structures.

Keywords: RE –Reinforced Earth, RS – Reinforced Soil.

1. Introduction:

An internally stable system like reinforced earth involves reinforcements put in among and increasing on the far side the potential failure mass. Reinforced earth may be a material shaped by combining earth and reinforcement. The reinforcement contains of reinforcing components that is within the style of strips set at sure intervals disposed in horizontal layers on the facing of the structure, an exact style of boundary or skin is needed to retain the planet particles that aren't to bear with Reinforced strips. A Reinforced soil mass is somewhat analogous to concrete therein the mechanical properties of the mass are improved by reinforcement placed parallel to the principal strain direction to atone for soil's lack of tensile resistance. The improved tensile properties are results of the interaction between the reinforcement and therefore the soil. The idea of mixing 2 materials of various strengths characteristics to make a material of larger strength is sort of acquainted. The concrete constructions are examples for such composite materials. It combines the high strength of steel with the high compressive, however comparatively low strength of concrete. Likewise, soils that have very little, if any strength also can be reinforced by the inclusion of materials with high strength. This mobilization of strength is obtained by surface interaction between the soil and therefore the reinforcement through friction and adhesion. The Reinforced soil is obtained by inserting protrusive or non-extensile materials like gold-bearing strips or chemical compound reinforcement among the soil to get the requisite properties (N and K. 2005). Soil reinforcement through gold-bearing strips, grids or meshes and chemical compound strips sheets is currently a well-developed and wide accepted technique of earth improvement. Typical early uses of earth reinforcement embrace use of branches of tree etc. to support tracks over boggy areas and to create hutments. Structures are engineered by insects and birds exploitation mud and leaves. These are all acquainted sights even nowadays this sort of principle is additionally employed in building elements of Great Wall of China and therefore the Babylonian temples. In the nineteenth century Passel used tree branches to reinforce back fills so as to cut back the planet pressure and thereby economize the retaining walls. Textile material was maybe initial employed in building in South geographic area within the early Thirties. the primary use of woven artificial materials for erosion management was created in 1958 by Barrett (N and K. 2005) the employment of Reinforced earth technique is primarily thanks to its skillfulness, value effectiveness and simple construction. The Reinforced earth technique is especially helpful in urban locations wherever accessibility of land is minimal and construction is needed to require place with minimum disturbance traffic. the development of Reinforced earth structure has become wide unfold in Geotechnical engineering follow within the last twenty years thanks to their simple construction and economy compared to those of typical ways. Reinforcement of soil, is practiced to enhance the mechanical properties of the soil being Reinforced by the inclusion of structural part like granular piles, lime/cement mixed soil, gold-bearing bars or strips, artificial sheet, grids, cells etc.

1.1 Principles:

Soil has associate inherently low enduringness however a high compressive strength. Associate objective of incorporating soil reinforcement is to soak up tensile hundreds or shear stresses at intervals the structure. In absence of the reinforcement, structure my fail in shear or by far more than the deformation. once associate axial load is applied to the strengthened soil, it generates associate axial compressive strain and lateral tensile strain. If the reinforcement has associate axial tensile stiffness bigger than that of the soil, then lateral movements of the soil can solely occur if soil will move relative to the reinforcement Movement of the soil, relative to the reinforcement, can generate shear stresses at the soil/ reinforcement interface, these shear stresses square measure decentralized into the soil within the kind of internal confining stress. Due to this, the strain at intervals the strengthened soil mass quantity than the strain in unreinforced soil for an equivalent amount of stresses.

1.2. Required soil properties:

The soil property needed to be taken into thought area unit effective shear strength parameter “c” and “ϕ” that area unit obtained by taking into thought pore pressure inside the soil. but shear strength of fill or soil incorporating multiple layer of reinforcement. In wall and slope, load obligatory on the soil reinforcement can increase if positive pore water pressure is allowed to develop. the event of adverse pore pressure in reinforcement fill wall are often prevented by providing acceptable avoidance. just in case the event of pore water pressure is ineluctable in water front construction exaggerated reinforcement is needed to be thought-about. Additionally to physical interaction of soil and reinforcement elector chemical interaction is additionally needed to be thought-about for style life to assess the sturdiness.

2. Literature Review

Prof.V.S. Chandrasekaran (1998) has presented Mechanics of Reinforced Earth Retaining Walls. In this paper substantially abecedarian design aspects for corroborated earth retaining walls. In this paper substantially abecedarian design aspects for corroborated earth retaining walls are covered. Then it's point out to need for shoulder logical and experimental studies under static and seismic condition on resemblant walls containing soil backfill. Then it's also explained that type of underpinning will have to named grounded on filler material environmental condition and cost and the system which allows to use locally available filler material will be salutary.

J.E. Sankey amdP. Segration have presented elaboration of seismic Performance in Mechanically stabilized structures, in this paper they bandy the Performance of MSW after the earthquake in Nothirdge, Koba and izmit, it's observed that in some cases seismic acceleration, indeed also little tortureresulted.in some cases rigidity of corroborated earth may allow minor endless distortion to do without torture. In some cases discriminational agreements were do and due to these panels were separated up to 75 mm, indeed also structure didn't collapse indeed also for safety they suggest that during designing height of the wall should be keep mind.

Dr.S.V. Mhaislkar (1998) has presented Faia element in corroborated soil walls. In this paper substantially point out the significance of fascia element. Then it's suggested that a developer has pay good attention while designing detail of fascia rudiments because it give a supporting system to the mechanically stabilized earth mass. It also provides a connection of underpinning so quality of facing material should be checked duly. In this paper function and types of facing units, construction of facing unit and construction with facing units – all these important points are covered.

3.Reinforced earth wall:

A Reinforced earth wall could be a coherent gravity mass that may be designed to satisfy specific loading needs. It consists of formed concrete facing panels, metalic (Steel) soil reinforcement and granular back fill. Its strength and stability square measure derived from the resistance interaction between the granular back fill and therefore the reinforcements, leading to a permanent and sure bond that makes a singular composite construction material.

3.1. Structural Applications:

Reinforced Earth is used in urban, rural and mountainous terrain for

- Retaining Walls
- Sea walls
- Bridge abutments
- Submerged walls
- Railway structures

- Truck dumps
- Dams
- Bulk storage facilities

3.2. Advantages:

The advantages of reinforced Earth technology include

- **Flexibility -** Reinforced Earth structures distribute loads over compressible soils and unstable slopes, reducing the need for deep foundations.
- **High load-Carrying capability, static and dynamic -** Applied structural loads are distributed through the compacted granular fill and earth pressure loads are resisted by the gravity mass.
- **Ease and speed installation -** Prefabricated materials and granular soil simplify construction and minimize the impact of bad weather.
- **Pleasing appearance -** Panels may be given a variety of architectural treatments.
- **Economy –** 15-50% saving over cast –in-place concrete walls, depending on wall height and loading conditions.

3.3. Importance of a geotechnical report in the design of reinforced Earth Structure:

Geotechnical data is vital to evaluating foundation conditions for any structure, even a versatile one sort of a Reinforced Earth wall. As always, the additional complete and higher quality the geotechnical information, the less conservative and additional economical the foundation design may be, and also the structure itself will mirror this economy similarly. This is often very true in these things.

3.4. Relationship between the coefficient of sliding and the friction angle of the foundation soil:

Most geotechnical reports offer data concerning the Co-efficient of sliding between the planned footing concrete and therefore the underlying soil, to be used for planning traditional reinforced concrete walls. However, a sliding plane should develop either between the reinforced soils, or entirely among the inspiration soil itself. Therefore, the friction angles of each the Reinforced earth back fill and therefore the foundation of soil should be renowned. An inexpensive estimate of the friction angle of the desired reinforced earth back fill may be created supported expertise with different materials compliant with equivalent granular specifications, however laboratory testing needed to work out the friction angle and cohesion of the foundation soil.

3.5. Stability of ground:

Stability of reinforced earth structures is dependent upon many factors. The number and length of the reinforcing strips is determined by considering the combined effects of the select and random backfill. The foundation and back slope materials, Surcharge loads, service life requirements and, if applicable, submergence conditions and seismic acceleration. Ultimately, stability is assured by providing a reinforced granular mass of sufficient dimensions and structural capacity, bearing on adequate foundation material, having a durable facing materials, well-chosen drainage and proper embedment of the toe of the wall. Reinforced Earth Structures are evaluated for external stability and internal stability. External stability considers the behavior of the site under the loading imposed by the reinforced Earth structure, and is under the loading imposed by the Reinforced Earth Structures, and is primarily influenced by site geotechnical and hydraulic conditions. Internal stability refers to the behavior of and interrelationship among the components of the Reinforced Earth structure itself – the facing, the reinforcing strips and the select backfill.

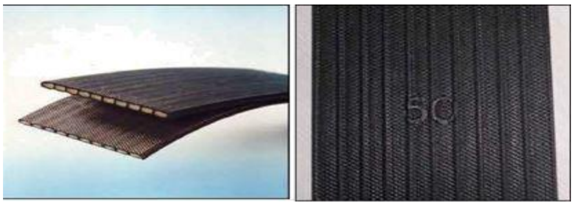
3.6. Slip joint:

Slip joints are continuous vertical joints provided at selected locations along a Reinforced Earth Structure. A slip Joint replaces the normal Vertical Joint system, substituting a vertical separation between adjacent panels that extends the full height of the wall. The sections of wall on either side of the slip joints are therefore, able to behave independently of each other. The Slip joint design uses either an exposed slip joint panel having its own reinforcing strips or a hidden “backup” panel in the backfill behind the facing panel.

4. Components of Reinforced soil wall system:

Paraweb reinforced soil wall comprises of thin pre-cast reinforced concrete fascia panels, polymeric strips Paraweb connected to the pre-cast units by passing around cavity shaped Connectors and passing around anchor bars at the rear, the earth fill and accessories, The connectors are cast into the panels. Paraweb is generally laid in zigzag pattern passing around the rear anchor bars. Rear anchor bar is used just to keep the Paraweb in position during the filling and compaction operation and has no design the filling and compaction operation and has no design significance. The Paraweb strips are typically spaced at 1.0m c/c in horizontal plane and 0.8m c/c in vertical plane.

Paraweb is provided in varied strengths between 30 to 100kN. The dimension of Paraweb strip varies between 85 to 90mm reckoning on the strength of strip. The width of Paraweb strip varies between 85 to 90mm depending on the strength of strip. Paraweb is supplied in rolls of generally 100m length. Each roll of Paraweb of particular grade has a packaging strip of specific color around the roll. A label pasted on each roll gives details such as type and grade of Paraweb, run number, width of strip. The strength of Paraweb is embossed on the strip at about 400mm c/c all along the strip. This helps to identify the strength of Paraweb during installation once the roll is opened up.



Paraweb & Strength Embossed on Paraweb

4.1. Connectors:

The Connector is made up of High Density Polyethylene (HDPE) and comprises of a cavity which is provided with a sleeve near the bottom through which the Paraweb is passed. A lid is provided over a connector to restrict the flow of concrete slurry inside. The Connectors are cast info the panel and are used to connect the Paraweb to the panels through sleeves. For Paraweb up to 75kN strength, 100mm deep Light-Connectors are used while for Paraweb with more than 75kN strength, 145mm deep Connectors also known as Heavy-Connectors are used. These Connectors are also used for lifting the panels from the base plate after casting and stacking them at required location.

4.2. I-Blots:

I blots are cast into the panel and are used for lifting the panel from the stack for erecting them at required location in the wall.

I-BOLTS

4.3. EPDM Pads:

These pads are used as seating in the horizontal joints between panels. They prevent direct contact between the panels and maintain gaps in horizontal joints thereby contributing to flexibility to the system. Generally three EPDM pads are placed in the recess provided on the top of panel before next panel is placed on it.

4.4. Joint Fillers (Vertical &Horizontal):

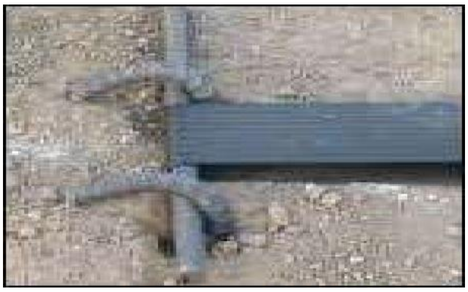
Non-woven geotextile are pasted/fixed on horizontal and vertical joints to prevent the loss of backfill soil/ aggregates through the joint.

4.5. Rear Anchor arrangement:

This arrangement is for providing temporary anchorage to the paraweb at the rear end of the reinforced soil zone till backfill is placed on it. The two constituents are as follows:

(i) **Hooks :** Hooks are in the form of 12mm diameter bars 300mm long. A pair of hooks in driven into the compacted backfill at spacing of 150mm for fixing the anchor bar.

(ii) **Anchor bar :** A steel bar of 12mm diameter bars 200mm length is anchored in position with the hooks around which the Paraweb is looped.



Rear Anchor Arrangement

4.6.S-Clamps:

Clamps of 6 to 8mm diameter steel bars made into 'S' shape are used at places where overlapping of paraweb occurs between two rolls(one roll which is already laid and the new roll which is to be laid in continuation as per requirement in drawing). The clamps provide temporary clamping till the back fill is laid.

S_Clamp

4.7.Wooden clamps & Wedge:

It is used to hold the panel in place during construction of Reinforced soil wall. Wooden clamps comprise of two wooden blocks of 0.3mX 0.1m X 0.050m and a MS steel rod of 12mm diameter and 425mm length passing through the wooden blocks. The MS rod is thread at both the ends for length of 75mm and has two nut washers to tighten the wooden clamp against the panels. A pair of wooden wedges is wedged in the joints between two panels to prevent movement of panels during construction of reinforced soil wall.

Wedges

4.8. Lifting Eye:

The panel is lifted from the "I" bolt for erecting it at the appropriate location in the wall. Lifting eye is a tool used to lift the panel from "I" bolt that are cast into the panel.

4.9. Backfill:

Select material satisfying the technical specifications and design requirement regarding the shear strength parameter angle of internal friction, maximum particle size, Percentage fines shall be used as backfill. The back fill material is placed in layers of specified thickness and compacted to specified density.

4.10. Drainage Arrangement:

It is necessary to provide suitable drainage arrangements to quickly drain off excess water from the fill material and thus, prevent development of pore water from the fill material and thus, Prevent development of pore water pressure. For drainage, filter media of gravel of 10mm to 20mm size is generally provide behind the fascia.

4.11. Types of Pre-Cast panels:

Panels are used for Paraweb reinforced soil wall system can be categorized into 4 different types as under:

- Standard Panels is designated as 'S' and are cast in standard panel mould.
- Base/Bottom panels is designated as 'P' and are cast in bottom panel mould.
- Top panels have different height and are designated as A,B,C,D,E,F,G,J,W,X,Y, & Z.
- Corner panel is designated as 'Q' and is cast in special mould for corner panel.

Panels A,C,E, and G are Cast in Standard panels moulds using horizontal shutter plate at appropriate location from the top shutter (shutter with cup for I bolt) so that required height as mentioned in the drawing is obtained. Panels B,D,F & J are Cast in cruciform panel moulds with the horizontal shutter plate at appropriate location from the top shutter. Panels W,X,Y, and Z are cast in Cruciform panel Moulds with the horizontal side shutter plate placed at appropriate location from the bottom and top shutter with I bolts cast in the top shutter plate.

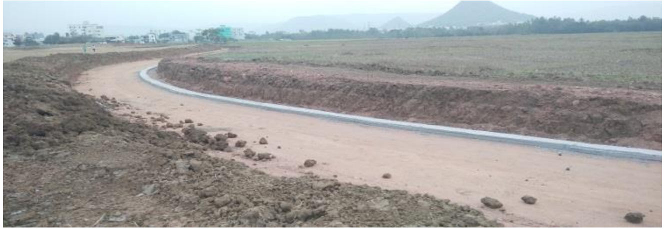
Cut panels are special panels with a cut on left or right side and are cast in standard or cruciform or bottom panel moulds as per the type of cut panel to be cast.

Table 1.0. Types of panels

Type	Name of panel	Bottom width (m)	Height (m)
Standard	S	1.83	1.6
Base/Bottom	P	2.16	0.8
TOP	A	1.83	1.0
	B	1.83	1.8
	C	1.83	1.2
	D	1.83	2.0
	E	1.83	1.4
	F	1.83	2.2
	G	1.83	1.6
	J	1.83	2.4
	W	2.16	1.0
	X	2.16	1.2
	Y	2.16	1.4
	Z	2.16	1.6
CORNER	Q80	-	0.8
	Q100	-	1.0
	Q120	-	1.2
	Q140	-	1.4
	Q160	-	1.6

5. Construction of RS wall

1. Excavate the formation to the required level. The surface of formation should be free from any deleterious material and unwanted foreign objects. Loose pockets if any, shall be excavated and filled with suitable granular material.
2. Roll the formation using Vibrio-roller of 8 to 10 tonnes capacity. Care should be taken to ensure that the design requirements with respect to bearing capacity are achieved. Density of formation to be checked as per QA plan. Density should not be less than 95% Modified Proctor Density for the formation.
3. The in-situ PCC levelling pad for the pre-cast panels shall be cast in line and to the level shown on the construction drawings to a tolerance of +/- 5mm. At the end of day’s work, if entire length of levelling pad is not completed, the end portion shall be sloped downwards to ensure a proper construction joint for the next day’s PCC work. An attempt should be made to avoid any construction joint in the levelling pad for closing wall. Preferably the construction joint in levelling pad should be at least 5m away from the corner panel location in the longitudinal portion of the wall.



Levelling Pad

4. Particular care should be taken to maintain correct line and level at footing steps.
5. Setting-out points or lines should be established on the top of the in-situ concrete base, and this line should be referenced to enable the setting-out line to be re-established as the construction proceeds.
6. Before panels are placed they should be carefully checked to ensure that no damage has occurred during transport and handling, either to the panels themselves or to the panel connector. An individual panel shall be lifted from the stack using lifting kit. The lifting eye shall be connected to the I-bolt at the top of panel and panel shall be lifted to vertical position. A piece of timber should be placed between the panels to avoid possible chipping at edges during lifting from horizontal to vertical position.
7. While lifting the panel using Hydra-crane for erection from the I-bolt, always use two sets of slings. One set for I-bolt and the other for top row of connector on the panel.
8. Generally the erection should start from existing structure and move towards end of structure (say from closing/cross wall to tail end). Place the corner panel (if required) as per the layout plan given in drawings. After leaving adequate space for cut panels, start placing the required number of bottom panels on the concrete base leaving space for full panels. If cut panel is cast out of bottom panel then erect cut panel besides the corner panel and then start placing the bottom panels.
9. Ensure the stability of the panels by appropriate propping from the front. To prevent the panels from falling backwards some filter media can be placed behind the panels up to the lowest row of Paraweb attachment points, or the panels can be temporarily propped from inner face till the filling is done to support the panels.

Panel Erection

10. Panels may need to be installed with a slight lean (forward or backward) depending on backfill soil behaviour and existing ground conditions. It is usual for panels to rotate forwards slightly during compaction of the fill behind the wall. Therefore, a slight backward lean (e.g. 10 to 15mm over the height of the panels) will counteract any forward rotation during construction. The lean provided to the panel being checked using a Plumb bob and measuring tape.
11. Conversely, for sites where settlements of foundation soils are expected, the panels may be installed with a slight lean in the forward direction. Any settlement during construction will pull the panels towards the vertical position. The appropriate amount of lean to be applied to the panels will be advised by the Engineer.

12. Check the following during erection:-
    a. Distance between adjacent panels on front side, can be checked with using a suitable spacer made of reinforcement steel. The spacer bar can be fabricated and calibrated to the correct measurement at the site.
    b. Level of top of panels using spirit level or water-level.
    c. Horizontal alignment allowing for any lean of the panels which has been applied. It is important to place these initial panels as accurately as possible, including the advised amount of lean, as any errors, particularly in the vertical alignment, may be amplified at subsequent levels.


Level checking of Panels

13. If any packing is required under the panel in order to obtain the correct level/alignment then, a “dry pack mortal” should be used. Wooden wedges should only be used for temporary transfer of load until the permanent packing material has cured.
14. After placing and securing all the bottom panels, re-check the panel to panel distance, the level at the top of the panels and the horizontal alignment of the panels. A running dimension over at least five panels and five gaps (where possible) should be checked on outer face and shall have a tolerance of not more than +/- 10mm.
15. Start placing the standard panels in the space between the half panels. Adequate care shall be taken to match the panels with reference to each other (in vertical direction) during the erection of panels. Prop the panels from outside once erected and clamp them using timber clamp.
16. Check the following during erection:-
    a. Distance between adjacent panels on front side.
    b. Level of top panels.
    c. Horizontal alignment allowing for any lean of the panels which has been applied.

    Some tolerance of +/- 2mm may be used up as the wall is erected so that the distance between adjacent panels will need to be optimized at each level in order to achieve the best fit and yet allow subsequent rows of panels to be erected at a later stage.

17. Where a bottom row is left incomplete ensure that the free end panel is always a half panel. Particular care will be needed at the ‘free’ end to maintain alignment.
18. To ensure that the panels do not move and are firmly held in place during further operations, hardwood wedges with the right combination are placed into the panel joints. One set should be placed in the vertical joints near the bottom of the panel being secured and another one near the shoulder. Care should be taken that these wedges are at least 150mm away from the comers of the panel. As far as possible, horizontal joints should be kept wedge free. However, if required wedges on a temporary basics may be used in horizontal joints and must immediately be removed once wedges in the vertical joints and the support clamps are tightly fixed.
19. If any adjustments are required, these can be easily achieved by easing the panel with a pinch or crow bar Care should be taken not to damage any concrete during this operation. It may be necessary to place a piece of wood between the bar and the concrete in order to avoid damage.
20. After placing all standard panels at one level again check the following:
    a. Distance between panel to panel using measuring tape
    b. Level of top of panels
    c. Horizontal alignment allowing for any lean of the panels, which has been applied.
    d. Distance between top and bottom panel to top of adjacent standard panel the lean back of the standard panel should conform to the lean of the half panels.
21. When all the panels placed have been aligned both horizontally and vertically, the vertical and horizontal joints should be covered with non-woven geotextiles.
22. Place and compact fill material in layers to meet the density requirements up to the first level of Paraweb attachment position. Only fill, which meets the design specification, should be used. Control over the grading of fill should be exercised. Stones of size more than 150mm should be removed from the fill.
23. Ensure that the fill level after compaction is not lower than the center of connector level. This is particularly important where post construction settlements may be expected or in the case of bridge abutments where very large surcharge loads will be applied.
24. Where local troughs or hollows exist, these should be filled in with fill material and compacted properly.
25. Measure out from the back face of the panels, the width of the reinforced soil zone as shown on the drawings at that level and fix the rear anchor bars.
26. Commence laying the Paraweb of specified grade by looping it around the rear bar allowing a 2.0m overlap. Pull the Paraweb shall be passed through the connector by looping around the bar inside the connector to anchor the Paraweb and continue laying back towards the rear anchor bar. Loop the Paraweb around the rear anchor bar and return towards the panels and the next connector.

27. Repeat this sequence until the Paraweb has been loosely laid over the whole area.
28. When all the Paraweb has been loosely laid out adjust the spacing of the Paraweb at the rear end. Then return to the beginning and commence tightening the Paraweb.
29. To connect two lengths of Paraweb a lap joint is formed in the rear end of the structure. The lap should be 2.0m long and the two pieces of Paraweb temporarily secured together with a steel S-clamp so that they do not become detached during filling operations. Before connecting two lengths of Paraweb it is best to remove the slack from the previously laid length to avoid the migration of laps towards the panels during the final tightening process.
30. Where it is necessary to cut the Paraweb, thus creating an unsealed end, the end must be sealed by bitumen before any fill is placed over it.
31. Loop the final length of Paraweb around the rear bar with a 2.0m overlap and fasten with a steel clamp.
32. Where appropriate use crowbars to thrust back the rear anchor bar and drive the steel pins into the ground to hold the tautness so induced.
33. Final tightening of the Paraweb can be achieved by two or three men working systematically from one end to the other. With one man at the rear bar and one man at the back of the panels the Paraweb is pulled through the connector till the entire stack is removed. Keeping this section of Paraweb tight the man at the rear bar pulls the next length of Paraweb tight through the next pair of attachment loops. This procedure is repeated for all the Paraweb lengths until the end is reached.
34. Care should be taken not to over-tighten the Paraweb as this could cause the panels to be pulled backwards. The objective should be to remove all slack.
35. At some locations Paraweb design length is not achieved due to skew in the structure. For such locations, special Paraweb layout drawings are issued by design team. In case of any variation noticed in the angle of skew measured at a corner location then, the same should be brought to attention of designer.

Paraweb Laying

36. Filling can proceed in layers in according with the QA plan. The layer thickness shall be marked on the panel at definite interval. The fill material is carefully deposited on the top of the Paraweb and then spread and compacted.
37. Where space allows, the first deposits of fill should be at the rear of the structure leaving the area immediately behind the facing panels unfilled. Tracked vehicles should not run directly on the laid Paraweb.
38. Great care should be exercised when placing; spreading and compacting fill to ensure that heavy plant is kept away from the area immediately behind the panels. Fill should be spread in a direction parallel to the facing panels.
39. In no circumstances should fill be pushed directly towards panels, particularly in the area immediately behind the panels, nor should fill be placed immediately behind the panels by dropping from the spreading machine's bucket.
40. Heavy compaction plant must not be used within the area 2.0m from the panels instead a walk behind roller or baby roller can be used. A limit of 1.0 tonnes should be placed on the weight of plant permitted within 2.0m of the back of the panels. Nevertheless adequate compaction should be achieved and density tests taken, ensure the following points:-
    a) The truck does not drop the fill close to the panel
    b) The fill material does not get mixed with the filter media
    c) The truck and the grader run parallel to the panels and do not come within 0.5m from the face of the panel at any stage
41. Before starting the compaction process, ensure that all the wedges and support clamps are held tightly in their place
42. Run light roller first within 2m from the panels followed by heavy roller beyond 2m from the face of the panels. Even light roller should not be allowed to come within 0.5m distance from panel face. This area is to be compacted using vibrating plate and rammer.
43. It may be difficult to achieve good compaction plant such as vibrating plates and rammers. Where the use of these cannot be avoided care should be taken to ensure that the layer thickness used in small enough to ensure the required density is reached. Particular care should be taken when compacting in the proximity of units, which form corners to structures where space is restricted but where nonetheless adequate compaction should be achieved.
44. When this first volume of fill has been placed and spread, then the material immediately behind the panel can be placed and compaction can proceed.

45. Immediately upon completion of compaction of a layer of fill the alignment of panels should be checked. If the panels have rotated more or less than anticipated, it may be necessary to adjust the lean of subsequently placed panels.
46. Should any gross misalignments occur then, it should be corrected immediately before any further fill is laid. Panels should be freed, dismantled to the level at which the error has arisen and then erection recommenced.
47. Where panels are skewing, or difficulty is being experienced with alignment, it may be helpful to use additional wedges at the location where the slight deformations are occurring. These wedges must not be placed within 150mm of the corner of the panel nor in horizontal joints. If skewing continues the matter should be referred to the Engineer for advice as soon as possible.
48. When the level of the fill material reaches the top of panels, EPDM pads are placed on top of the panel and the next row of panels is placed and clamped with exiting panels using wooden clamps.
49. After the newly placed panels have been checked for line, level, lean back, horizontal distance between the panels and distance between top of existing panel to top of newly erected panel, the newly erected panels are wedged to those already in place. Horizontal and vertical alignment must be related to the previously established setting out line.
50. More care than usual may be necessary in those areas where settlements occur. However, the system of maintaining alignment by referring back to a base datum will be more satisfactory than aligning from one panel to the one below.
51. The appropriate lean for each row of panels and the position of the bottom and top of the panel relative to the base datum should be determined before positioning the panel.
52. The fill material can now continue to be placed until the level of the fill once again reaches the next level of attachment points for the Paraweb.
53. Check the alignment, level and lean of the panels. Adjust where necessary and possible. If gross misalignment occurs the panels must be dismantled to the level at which the error has arisen, and erection recommenced.
54. As a check, the panels should be monitored regularly with a theodolite or laser to pick up any movements, which are approaching the tolerances. Thus correct action can be taken quickly and with minimum disruption.
55. The procedure described above should be repeated until the top of the structure is reached.
56. The props supporting the bottom row of standard and half panels should not be removed before the level of fill material is at least 2.4mm from the foundation level of the wall.
57. All wedges should be removed only after fill has reached a level of 3.2m above the position of the wedges, or the top of the wall is reached, whichever is the sooner. Wedges should be carefully removed to ensure that there is no sapling of the concrete panels.
58. In the event of any problems occurring, the Engineer must be informed as soon as possible, no matter how minor the problems may be considered. Variation from the above procedures must not occur without the approval of the Engineer. All the quality check formats should be duly filled as the erection of wall progresses.

6. Conclusion:

Reinforced earth walls have evolved as viable technique and contributed to infrastructure in terms of speed, easy construction, economy, aesthetics etc. it's a technology that must be understood well in terms of its response, construction options etc. Failures of RE walls have conjointly been noted during a few places thanks to lack of understanding of behaviour of RE walls. Soil reinforcement through metallic strips, grids or meshes and chemical compound strips sheets is currently a well-developed and wide accepted technique of earth improvement. The use of reinforced earth technique is primarily due to its skilfulness, value effectiveness and easy construction. Soil has associate degree inherently low enduringness however a high compressive strength. The strain among the reinforced soil mass quantity than the strain in unreinforced soil for constant amount of stresses. Once associate degree axial load is applied to the bolstered soil, it generates associate degree axial compressive strain and lateral tensile strain. a spread of Materials are often used as reinforcing part e.g. steel, concrete and wood , rubber, aluminium, thermoplastics. In the design of reinforced Earth structure 2 main criteria are used to develop the size and layout, they're external stability and internal stability. The external stability considers the structure as a full and checks the soundness for sliding, overturning, tilt and slip. Internal stability covers the inner mechanism (tension and pull-out failure) among the structure, arrangement and behaviour of reinforcement and backfill. Some of the applications of reinforced earth includes its use in stabilization of the soil by increasing California Bearing ratio (CBR) of the soil. the foremost common application of reinforced earth is mechanical stable earth wall (MSEW). MSEW are often utilized in reinforced containment dikes that is economical and may conjointly end in savings of land as a result of vertical face are often used, that reduces construction times.

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