METHOD FOR CONSTRUCTING FRAME FOR RETAINING EARTH

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ABSTRACT
Between each pair of wales horizontally supported on sheet-pile walls in facing relationship, struts spaced apart in parallel are provided to form an earth retaining frame. Each strut comprises a plurality of standard strut elements connected together, a junction of which is forced apart by a hydraulic jack which is interposed between the strut elements eccentrically of the axis of the strut. In the space thus expanded between the strut elements, an auxiliary strut element and a screw jack are provided. The strut is formed of the standard elements, auxiliary element and screw jack arranged in combination in pressing contact with the wales against the earth pressure.

3 Claims, 5 Drawing Figures
Fig. 2

Fig. 3

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BACKGROUND OF THE INVENTION

It is desired that the frame for keeping earth out of an excavation formed in carrying out foundation work for buildings and other structures have the following characteristics. Firstly, the frame must be capable of withstanding the earth pressure. Secondly, when assembled in an excavation, the frame must leave a sufficient space available for construction work. Thirdly, since the frame is a provisional structure to be removed when the foundation work is completed or as the construction work proceeds, the frame must be easy to assemble, disassemble and remove and have a further advantage that the constituent members thereof can be used again. Fourthly, the frame must have amenability to varying size.

An earth retaining frame has heretofore been built at the construction site by assembling timbers, steel members or the like which are cut off or joined together in desired dimensions. In such case the strength of the frame to withstand a particular earth pressure and the size of a work space to be made available are generally determined by the workmen at the construction site based upon their experience, and accordingly assembling of the frame requires sufficient experience and skill. It is further noted that a certain percentage of the materials used for the frame are not fit for reuse after being disassembled.

SUMMARY OF THE INVENTION

The present invention relates to a method for constructing a frame to be used at the construction site for retaining earth.

An object of this invention is to overcome the above-mentioned drawbacks of conventional earth retaining frames and to provide a method for constructing a frame for retaining earth which fulfills the foregoing requirements as an ideal frame for such use.

To form an earth retaining frame in accordance with the present invention, struts spaced apart in parallel are provided between each pair of wales horizontally supported on opposite sheet-pile walls driven into the ground, each of the struts comprising a plurality of strut elements having standard dimensions and connected together. An expanded space is formed between a junction of the strut elements by means of a hydraulic jack disposed eccentrically of the axis of the strut for pressing the opposite ends of the struts against the wales, the jack being inserted between brackets detachably mounted on the opposite ends of strut elements defining the space. In the space thus expanded, an auxiliary strut element and a screw jack, the sum of the lengths of which is approximately equal to the length of hydraulic jack in the retracted state, are provided and the screw jack is extended in pressing contact with the end of the strut element. The hydraulic jack and the brackets are then removed, whereby the strut can be retained in pressing contact with the wales against the earth pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view showing a frame for retaining earth constructed in accordance with the method of this invention;

FIG. 2 is a perspective view showing the principal part thereof as it is disassembled;

FIG. 3 is a perspective view showing the principal part with auxiliary assembling means in use;

FIG. 4 is a perspective view showing a constituent member;

FIG. 5 is a plan view showing part of the frame.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the present invention will be described below in detail. First, along the periphery of the ground to be excavated, interlocking steel sheet piles 3 or H-shaped steel tiles 4 are driven into the earth to a predetermined depth so as to form an enclosure. In accordance with the depth of the excavation, sheet piles 5 made of timber are inserted between the steel piles 4 one after another to form a sheet-pile wall 2, or when the interlocking steel sheet piles 3 are used, a sheet-pile wall 1 extending to the predetermined depth is formed. When the excavation proceeds to a given depth, a first earth retaining frame unit 7 is assembled to support the sheet-pile walls 1 and 2 against the earth pressure. As the excavation further proceeds, a second earth retaining frame unit 8 is assembled. Thus, in accordance with the depth of excavation, the frame units for holding back earth are constructed one after another.

As described above, the first frame unit 7 is built at a shallowest position and it is assembled in the following manner. When excavation proceeds to such extent that earth has to be held back, rows of support members 32 are provided, at the same level, on the inner faces of the sheet-pile walls 1 in facing relationship. On the adjacent sheet-pile walls 2 at a level lower by a predetermined distance, rows of support members 32 are likewise provided in face to face relation. A pair of wales 9 and another pair of wales 10 (partly illustrated) and then placed on the rows of support members 32 in facing relationship along the sheet-pile walls 1 and 2 respectively. Each of the wales 9 and 10 comprises a desired number of elongated, standard wale elements 17 having a uniform length and connected together in alignment, the wale element 17 being H-shaped in section and closed at its ends in the form of a rectangular box. If the overall length of a plurality of the wale elements 17 connected together is short of the entire length of the sheet-pile wall 1 or 2 by a fraction of the standard length, an auxiliary wale element having a special length is used in combination with the standard wale elements to cover the fraction. Such auxiliary wale member, generally used at the corner of the sheet-pile walls 1 and 2, also serve to make up for small errors.

To the joint of the wale elements 17 constituting the wale 9 or 10 a reinforcing plate 31 is fixed for reinforcement, while the wales 9 and 10 are jointed together by an angular corner piece 24 in steplike manner.

Between the wales 9 and 10, horizontal struts 12 and 11 are respectively provided in parallel in suitably spaced apart arrangement. The horizontal strut 11 or 12 comprises a plurality of strut elements 18 having a standard length, an auxiliary strut element 27 for covering a fraction of the standard length and a screw jack 26 which are connected together in a row. How-
ever, it is almost impossible to provide the horizontal strut 11 or 12 between wales 9 or 10 and to cause the strut to extend in pressing contact with the wales. It is to be noted that the screw jack 26 is interposed between the strut elements 18 of the horizontal strut merely to adjust the length of the strut and not to utilize the inherent function thereof. For the installation of the horizontal strut, there are prepared a number of auxiliary strut elements which vary stepwise in length and which are interchangeable and adapted to be joined together or disassembled by means of nuts and bolts. A hydraulic jack 29 is also prepared which serves as auxiliary means for assembling and is extendible to a predetermined extent.

The total length of a plurality of the strut elements 18, the length of the hydraulic jack 29 (i.e. the adjustable range of safety stroke of the hydraulic ram), and the length of a suitable auxiliary element 27 which are arranged in a row in combination now define the overall length of the strut 11 or 12, namely the distance between the wales 9 or 10 in facing relationship. More specifically, if the difference between the above-mentioned distance and the total length of a plurality of the strut elements 18 is smaller than the length of the hydraulic jack 29, one standard strut element 18 is replaced with an auxiliary element 27 so as to make the overall length of the strut 11 or 12 slightly smaller than the distance between the wales 9 or 10 in facing relationship. In this arrangement it is most essential that the hydraulic jack 29, positioned at a junction of the strut elements 18 joined together to form the strut 11 or 12, is positioned eccentrically of the axis of the strut. For this purpose, the strut elements 18 at the junction are spaced apart end to end by a distance slightly larger than the length of the hydraulic jack 29 when it is not extended, while the outer ends of the strut elements 18 are brought into fitting contact with the wales 9 or 10. On the inner ends of the strut elements 18 at its junction, brackets 28 as shown in FIG. 4 are detachably mounted and the plunger portion of the hydraulic jack 29 is interposed between the brackets 28 eccentrically with the axis of the strut (see FIG. 3). Then pressure oil is supplied to the jack to cause it to extend and thereby exert pressure on the wales 9 or 10 against the earth pressure acting on the sheet-pile walls 1 or 2.

It is thereafter arranged that the sum of the length of a screw jack 26 in retracted state and the length of an auxiliary element 27 connected to the base of the jack 26 will be approximately equal to the length of the hydraulic jack 29 in normal state. The screw jack 26 with the auxiliary element 27 attached thereto is placed between the strut elements 18 which are forced apart by the hydraulic jack 29, the screw jack being in alignment with the strut members 18. The screw jack 26 is then operated for extension so as to bring the opposite ends into proper pressing contact with the strut elements 18 which are end to end relation at the junction, this being followed by securing with bolts to form the strut 11 or 12. The hydraulic jack 29 is then loosened for removal. The brackets 28 are also removed for reinforcement a pair of reinforcing members 30 are secured to the opposite sides of the strut elements 18 at their junction where the screw jack 26 is disposed.

The struts 11 and 12 thus formed are secured, by fastening members 33, to several piles 25 driven into the ground to the predetermined depth of excavation, whereby the struts are retained horizontally. The intersections of the struts 11 and 12 are also secured by the fastening members 33.

The joint of the wale 9 and the strut 12 and the joint of the wale 10 and the strut 11 are reinforced by diagonal braces 19 each end of which is fixed in place by a securing member 23. For the stepped joint of the wales 9 and 10 at the corner, a steplike brace 20 is likewise provided for reinforcement by means of securing members 23, the brace 20 being made up of brace elements 21 and 22 joined together in overlapping arrangement.

When a first earth retaining frame unit 7 has been completed in the foregoing manner, the excavated surface 6 is further dug to a given depth, whereupon construction of a second frame unit 8 will be initiated. In the same manner as above, support members 32 are attached to the sheet-pile walls 1 and 2 in rows, and pairs of wales 13 and 14, each comprising wale elements 17 joined together, are placed on the rows of the support members 32 along the sheet-pile walls 1 and 2. In the same manner as above, struts 15 and 16 are installed between the wales 13 and 14 respectively in intersecting arrangement, each strut being built of strut elements 18, screw jack 26 and auxiliary element 27 using a hydraulic jack in combination therewith. Thus the second frame unit 8 is constructed.

This procedure will then be followed by further excavation and in the same manner as above, a third frame unit and a fourth frame unit will be built in accordance with the extent of excavation.

As the main construction work proceeds, the whole frame or part thereof will be removed. In this case, the reinforcing plates 31, braces 19 and 20, fastening members 33, reinforcing members 30 are removed one after another by loosening bolts and nuts, and then the screw jacks 26 are loosened for the removal of the struts. Finally, the wales 13, 14, 9 and 10 and support members 32 are taken away. Such removal of the frame will be carried out while excavation is conducted.

As already described, in assembling a strut of the desired length for the earth retaining frame, a hydraulic jack, disposed eccentrically of the axis of the strut, is used as a member to connect strut elements provisionally, and, after the hydraulic jack is extended, a screw jack and an auxiliary member are substituted for the hydraulic jack which are approximately equal to the space formed by the hydraulic jack. Accordingly, it is required that the difference between the total length of the standard strut elements connected together and the distance between the wales in face to face relation be not smaller than the length of the hydraulic jack 29 in the retracted state. In the case where the difference, namely the resulting space which is less than the length of the standard member is smaller than the length of the retracted jack, one of the standard members is replaced with an auxiliary strut member of a given length, which, in combination with the strut elements, screw jack and auxiliary element, provides an overall length almost equal to the length of the desired strut. Some shortage of the length will be made up for by extending the screw jack.

It will be apparent that the method for constructing an earth retaining frame in accordance with the present
invention can be practiced by using a plurality of standard elements of a given length, a small number of auxiliary elements varying stepwise in length, several screw jacks, braces for reinforcing corners, bolts and nuts for securing the constituent members, reinforcing members, hydraulic jack and brackets therefor. These constituent materials and devices have a high interchangeability for repeated use, and hence are economical. Thus it becomes possible to use constituent members of sufficient strength from the viewpoint of economy and to secure a greater working space within the excavation where the frame is built. This is a great advantage since a great number of machines are used at the construction site. Furthermore, the earth retaining frame in accordance with the present method does not require special skill to construct and can be built easily by any person with safety and in a short period of time. The constituent materials are convenient to transport and store. Thus, the present method ensures great advantages in constructing frames for retaining earth.

I claim:

1. A method for constructing a frame for retaining earth at an excavation site, said method comprising: forming opposed vertical retaining walls; horizontally mounting wales on said opposed retaining walls; and forming a plurality of struts to be positioned between said opposed wales to press said wales against said retaining walls; said step for forming each of said struts including connecting a plurality of standard length strut elements together while leaving a space between two adjacent strut elements, connecting an expanding means between said two adjacent strut elements across said space, said connected expanding means being aligned eccentrically of the axis of said strut, operating said expanding means to move said outer ends of said strut elements into contact with said opposed wales while expanding said space, positioning an auxiliary strut element and a screw jack in said expanded space, extending said screw jack such that said screw jack, said auxiliary strut element and said standard length strut elements form said strut, and removing said expanding means; whereby said struts press said opposed wales against said retaining walls.

2. A method as claimed in claim 1, further comprising securing reinforcing members over the junction of said auxiliary strut element and said screw jack with said strut elements.

3. A method as claimed in claim 1, further comprising selectively repeating said constructing as the excavation at said excavation site continues.