APPENDIX - I

SPECIFICATIONS OF NEW PATENTED DIAPHRAGM WALL CONSTRUCTION.

APPENDIX - I.

Specifications of New Patented Diaphragm Wall Construction.

The invention is an improved geotechnical process and a construction technique for composite structural diaphragm walls. It is a patented process under number 221/Bom and is described as below.

A. Steps common to both old and new practice :

(i) Guide Wall Construction.

The main purpose of the guide wall is to guide the trenching tool to help ensure the formation of a uniform and vertically aligned trench. The other purpose is to serve as a guide channel and reservoir for the bentonite slurry during excavation.

(ii) Slurry mixing operation

The bentonite slurry is prepared by standard mixing process to the desired consistency limits depending on ground conditions. The slurry is used for maintaining the trench sides while excavating to depth.

(iii) Slurry trench operation.

The trench operation is performed by a suitable mechanical excavators employing the bentonite slurry as in oil well constructions to maintain trench sides.

(iv) Tremie concreting.

The placing of concrete is performed by means of tremies. It is a standard practice followed in deep concreting.

B. Steps of New Process :

(i) Guide wall construction.

Same as in old process described above.

(ii) Guide Post Erection.

Holes of designed diameter spaced in accordance with panel size are bored employing slurry drilling technique. R.S.J.beams are erected in the slurry and holes are then book-filled with weak concrete mix. The primary object of these posts is to serve as guides for the proper alignment of tensagrity structural box. Besides, it provides leakproof jointing system between adjacent panels.

(iii) Slurry mixing operation.

Same as in old process described above.

(iv) Slurry cum lining trench operation.

The trench operation is performed by a suitable mechanical excavation employing the bentonite slurry as in oil well construction to maintain the trench sides. A further step is incorporated in which simultaneously a stabilized lining is created on the concept described previously. The process of creating sand stabilized lining involves operation of gun and nozzle fitted with non-return solenoid valve. Air motor is installed in the box of gun which is run by compressed air. The speed of the air motor is controlled by the valve. The motor can be run at various speeds according to the adjustments of the valve. Ordinarily a pressure between 50 to 60 psi is essential in the gun chamber for adequate blow out jet. However, the requirement of the pressure increases with the depth of operation below the gun, the length of hose pipe and the characteristics of the nozzle. The nozzle is such that dry sand particles get ejected centrifugally to disturb the bentonite slurry and to check the entry of bentonite slurry into the chute a non return solenoid valve is incorporated. As a result of the process, there occures an imbalance in the mechanical and electrical forces producing a stabilized lining on the trench sides. This step provides additional stabilizing force to maintain trench sides even in loose cohesionless soils, very soft clays, loosely bonded gravels and fragmented boulders in grounds. This step is absolutely essential for the above ground situations since the trench need not be stable only under bentonite slurry as established on theoretical considerations and experimental observations.

(v) Fabrication of instrumented 'tensogrity structural box'.

The structural box is developed and fabricated on the concept described previously. Based on the tensogrity concept a unique configuration is accomplished which can resist the high compressive stresses from the sides. The structural frame consists of a system of tetrahedrons formed from steel bars. The tetrahedron made of high tensile wires radiating from the hub member joining the columnar structure and is designed to produce tensional stresses in the entire frame when subjected to tensioning through standard nut system. The structural frame thus fabricated is cladded by high sectional modulus corrugated sheeting of wave form to transfer the loads. An instrumentation system consisting of strain wire gauges is built-in the pipe and hub at suitable intervals. This provides continuous performance observations during and after construction.

(vi) Plugging Operation.

A concrete plug is to be formed by tremie concreting at the base of the trench. The function of the concrete plug is to provide a proper foundation to the structural box element. It also helps in forming a level surface which is otherwise irregular as a result of improper breakage during excavation.

(vii) Positioning of Structural Box

The prefabricated structural box of suitable dimensions is lowered with standard mechanical system through the slots in the guide posts previously erected. Simultaneously with the lowering process the bemtonite slurry is pumped out through side pipes and refined for repeat use. The rate of box lowering and slurry pumping is kept adjusted in such a manner that the cutting edge as well as the bottom spikes remained in slurry all the time.

(viii) Grounding of structural Box.

The structural box in which the cutting edge and spikes are built in at the bottom of the frame anchors itself in the green concrete under its own weight. A light hammering can be resorted to for proper grounding and anchorage in the bottom concrete without any adverse effects.

(ix) Tremie Concreting.

The basic facility occured due to the structural box is the tremie concreting in dry enabling to produce a quality concrete. Further, since the structural frame is under tension before concreting hence when concreted, it results into a prestressed concrete member. As a result of which an economical and high quality composite concrete diaphragm wall construction is achieved.

MAIN ADVANTAGES :

Most of the principal drawbacks in the present practice of constructing concrete diaphragm is eliminated.

Following are the main advantages of the invention:

(i) It enables the construction of diaphragm walls in most ground situations particularly in loose cohesionless soils as also in very soft cohesive soils.

(ii) It provides the possibility of adopting the construction to the expected stress and strain conditions during construction.

(iii) It ensures the desired shape of the wall perfect alignment and better quality concrete.

(iv) It permits good utilization of the permissible stresses in steel and concrete, making overdesigning not essential.

(v) It facilitates the performance observations during and after construction because of built in instrumentation system.

DESCRIPTION OF THE DRAWINGS.

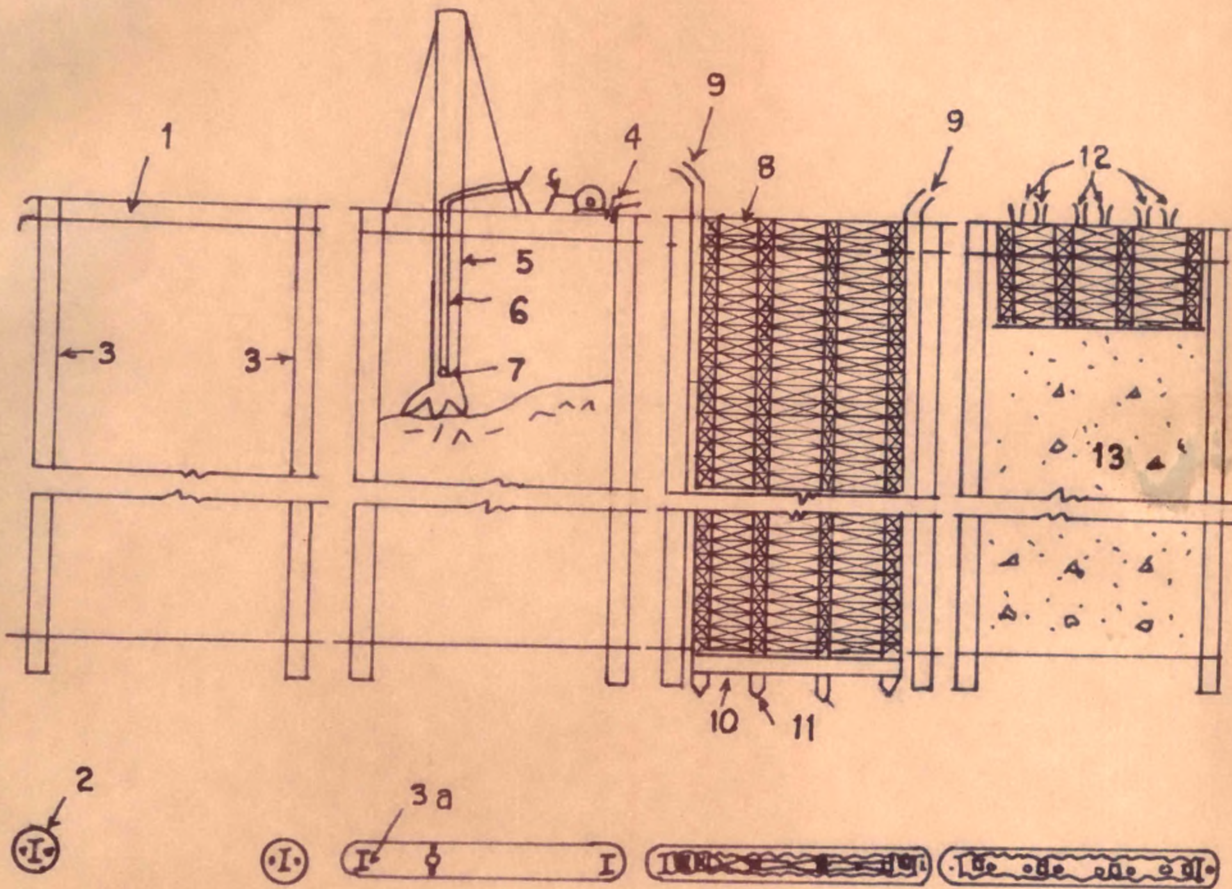

FIG:- I-1A FIG:- I-1B FIG:- I-1C FIG:- I-1D.

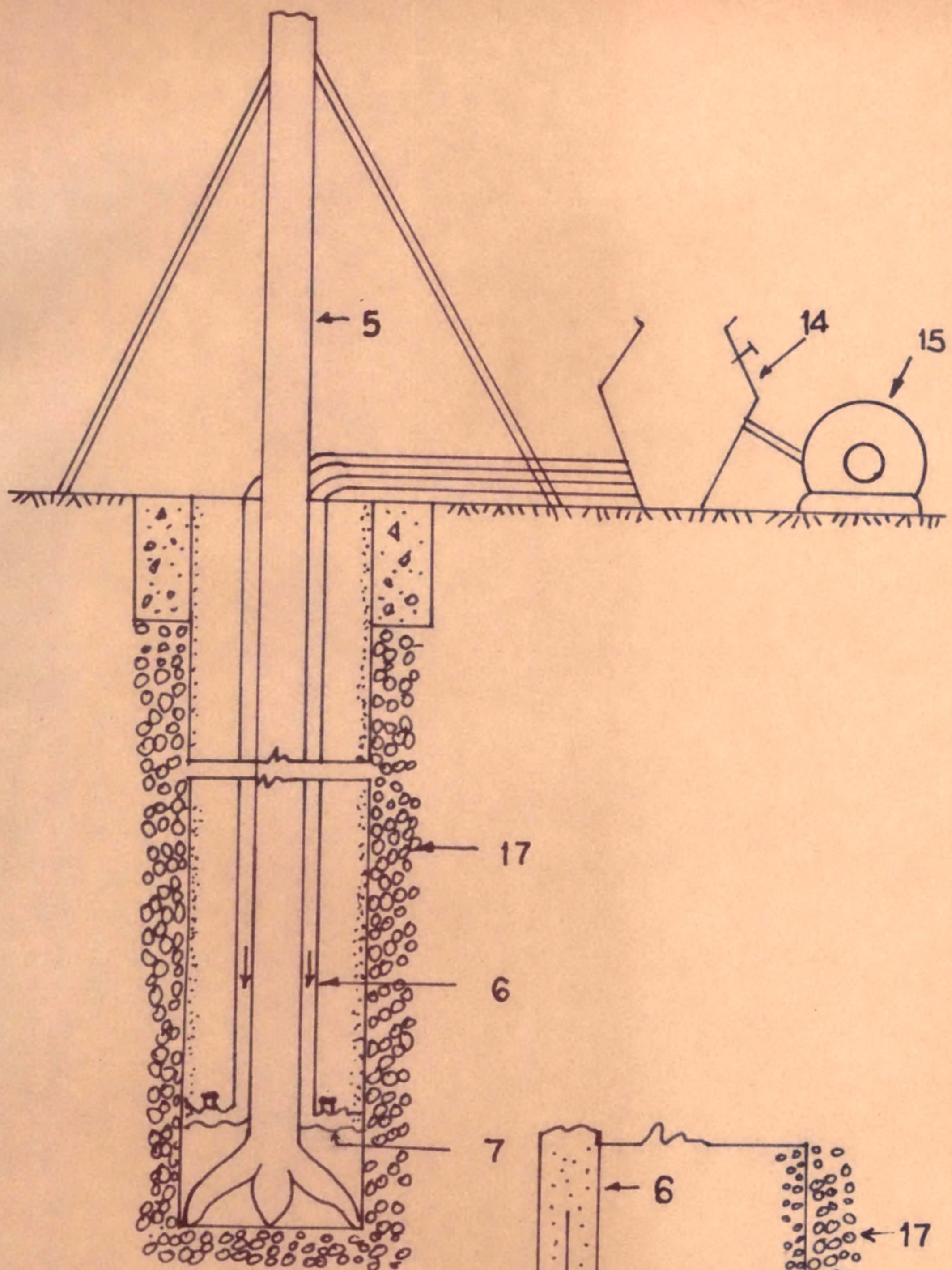

FIG:- I - 2 A

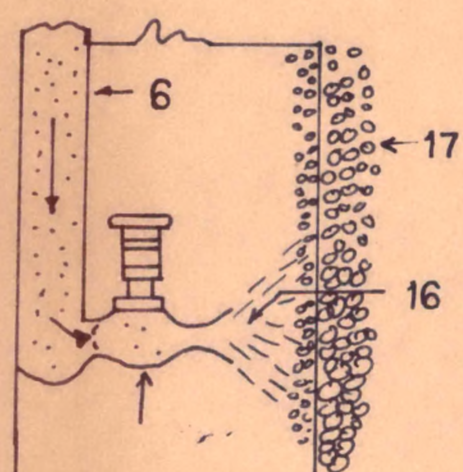

FIG:- I - 2 B.

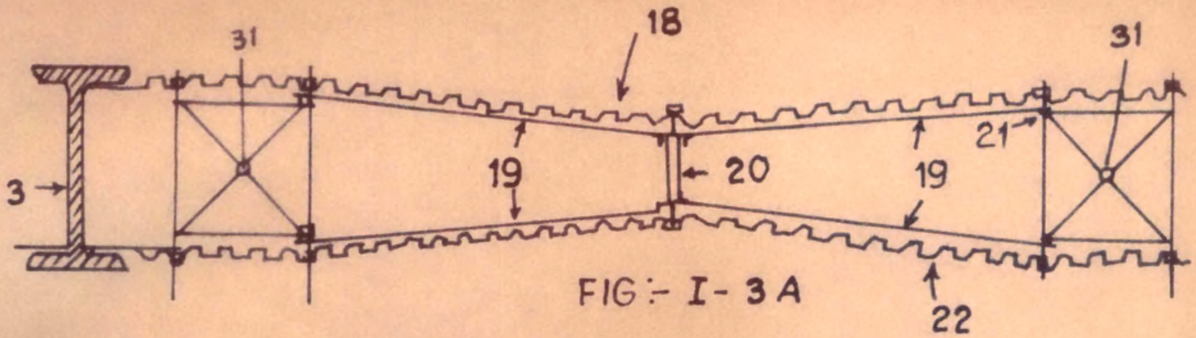

FIG:- I- 3 A

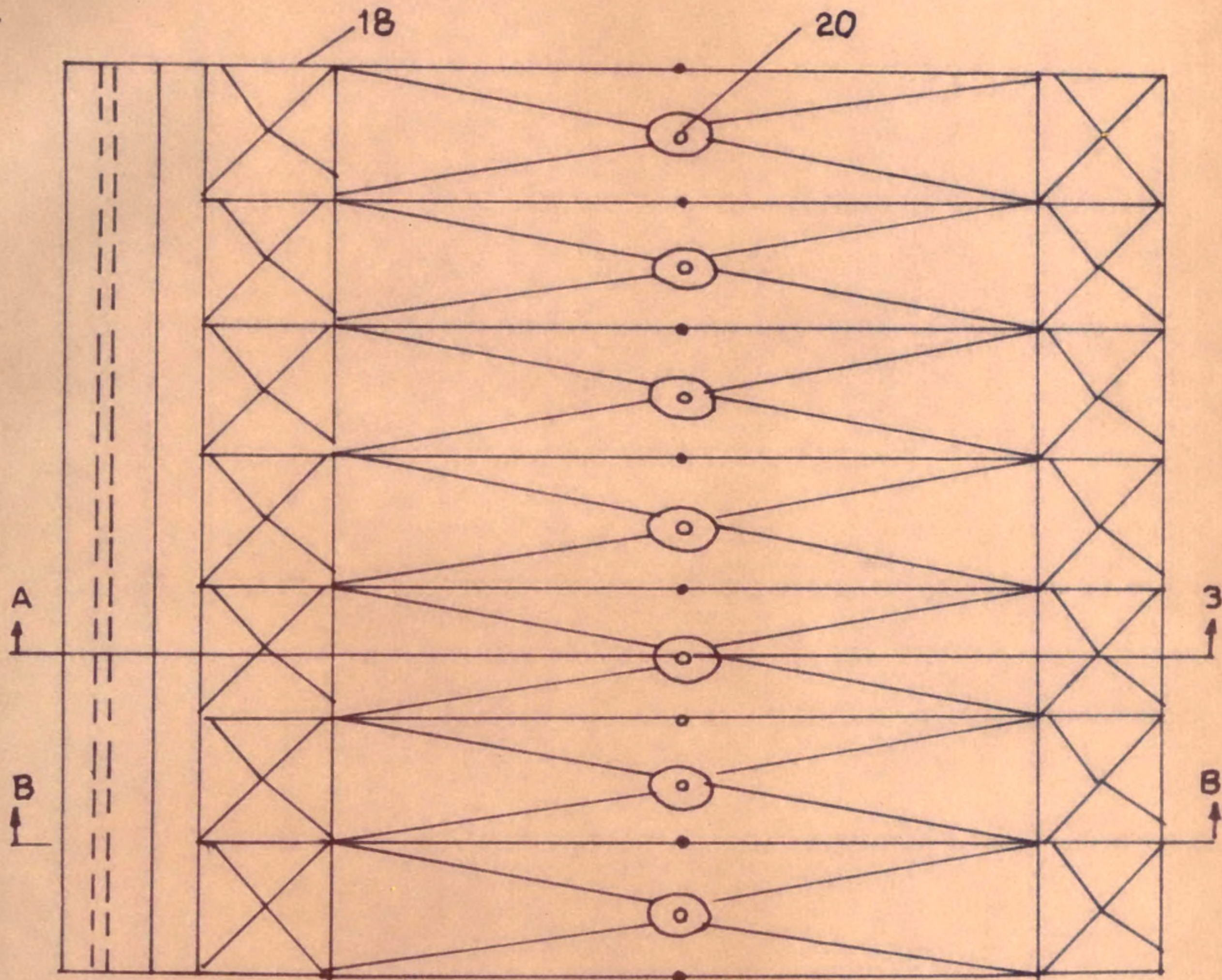

FIG:- I - 3 B.

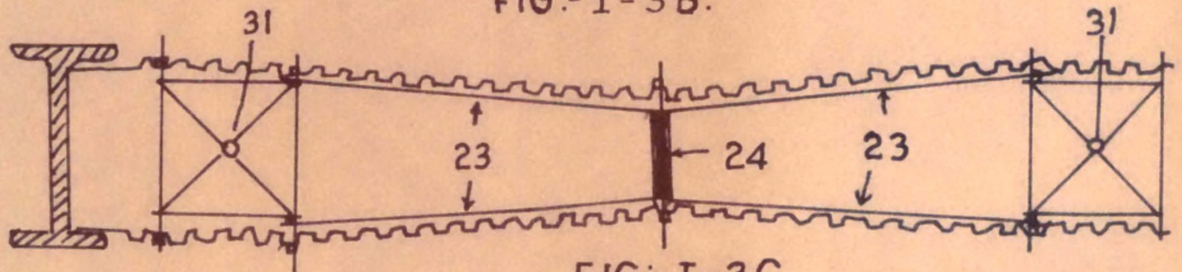

FIG:- I - 3 C.

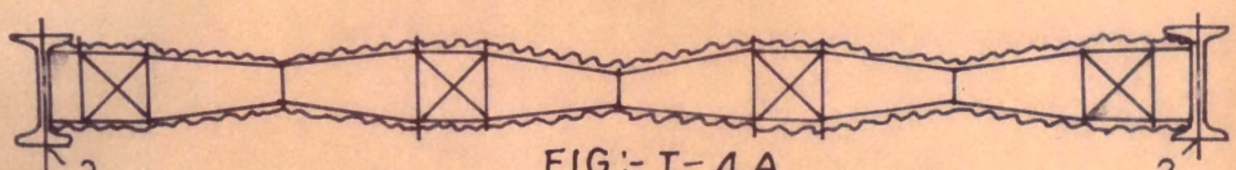

FIG:- I-4A

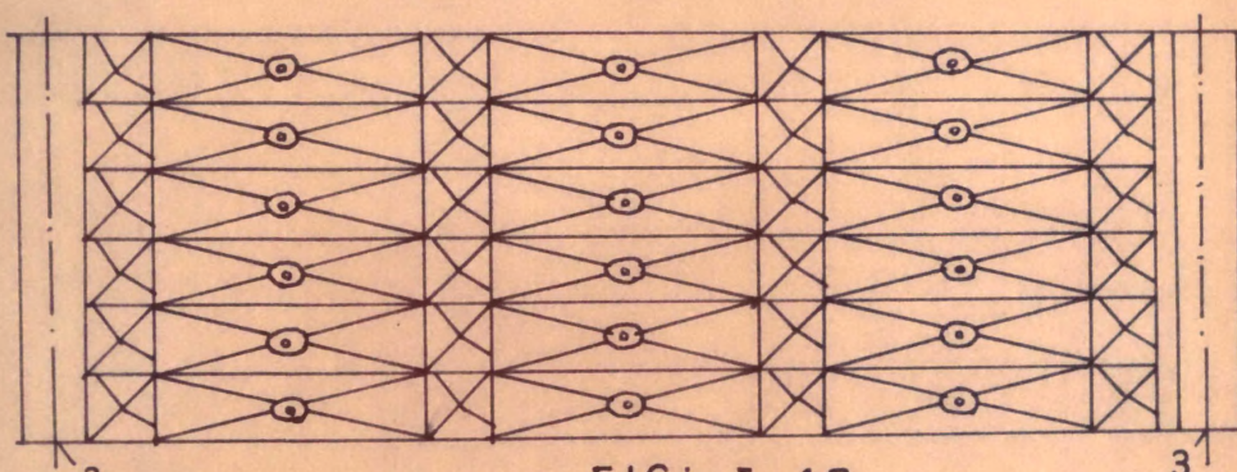

FIG:- I-4B

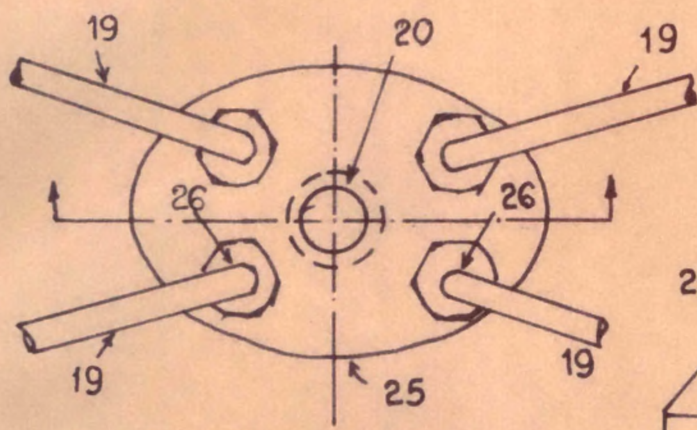

FIG:- I-5A

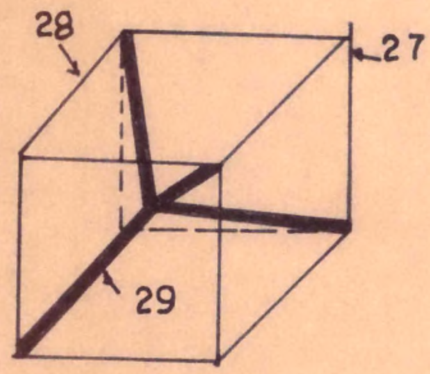

FIG:- I-5C

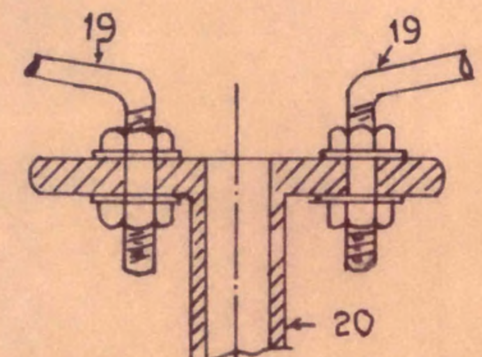

FIG :- I-5B

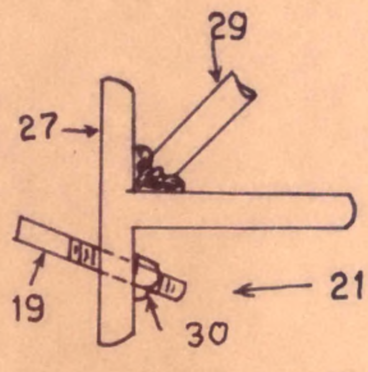

FIG:- I-5D.

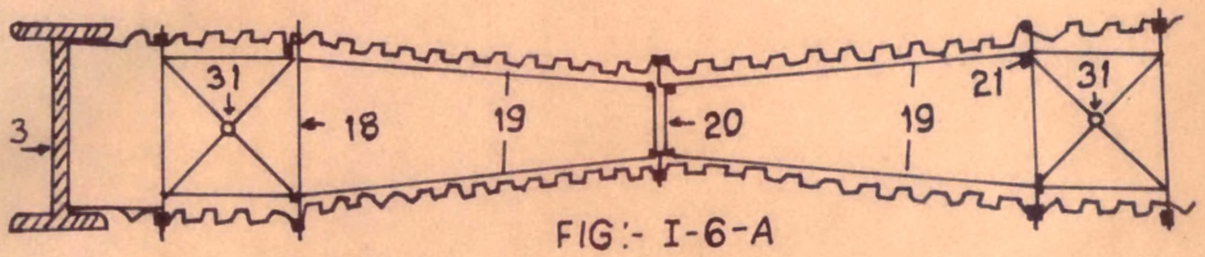

FIG:- I-6-A

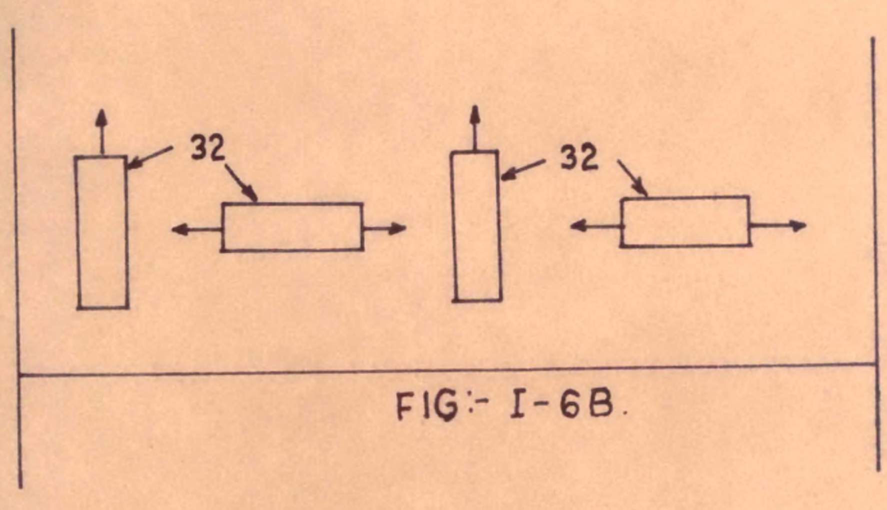

FIG:- I-6B.

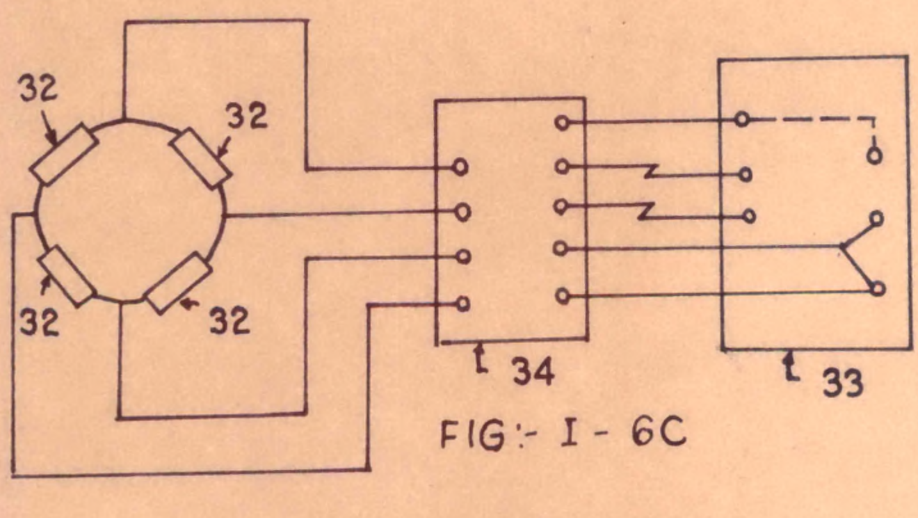

FIG:- I - 6C

DESCRIPTION OF THE DRAWINGS.

Figure 1 illustrates the sequence of operation for forming a concrete diaphragm wall.

Figure 1 A illustrates the operation for erecting guide posts.

Figure 1 B illustrates the slurry cum lining level operation.

Figure 1 C illustrates the positioning of structural box.

Figure 1 D illustrates the ~~cannelling~~ concreting operation.

Figure 2 illustrates schematically the geotechnical process for creating a sand lining incorporated with slurry trench operation.

Figure 2 A illustrates the various arrangements for the geotechnical process.

Figure 2 B illustrates a general profile of nozzle with non return solenoid value.

Figure 3 shows the canfiguration of the structural box.

Figure 3 A shows the plan of the structural box at section A A.

Figure 3 B shows the front elevation of the structural box.

Figure 3 C shows the plan of the structural box at section B B.

Figure 4 shows the cenfiguration of the structural box over the entire panel length.

Figure 4 A shows the plan of the structural box.

Figure 4 B shows the elevation of the structural box.

Figure 5 illustrates further details of the structural system.

Figure 5 A illustrates elevation joining arrangement of high tensile wires with the hub member.

Figure 5 B illustrates the joint system in plan at section A A.

Figure 5 C illustrates the elemental tetra unit.

Figure 5 D illustrates the nut tensioning system.

Figure 6 illustrates schematically the instrumentation system.

Figure 6 A illustrates the strain gauge arrangement.

Figure 6 B illustrates the measurement arrangement.

With reference to the Figure 1, (1A, 1B, 1C, 1D) the sequence is described as below.

(i) The guide trench (1) is prepared to the required dimensions to serve as a guide channel for trenching tool and reservoir for bentonite slurry.

(ii) Holes (2) of designed diameter spaced in accordance with panel size are bored employing slurry drilling technique. R.S.J. beams (3) are erected in the slurry and holes are then backfilled with weak concrete.

(iii) The guide trench is filled with bentonite slurry pumped through a conduit (4) from the pumping station where it is prepared.

(iv) The trench operation is performed by excavator (5) (the type of equipment shown in the figure is only illustrative) incorporated with chute (6) with a nozzle (7) fitted with non-returnable valve operating by a solenoid.

(v) The prefabricated structural box (8) of suitable dimensions is lowered with standard mechanical system through the slots in the R.S.Js. (3) simultaneously with the process, the slurry is pumped out through pipes (9) and refined for repeat use. The rate of box(8) lowering and slurry pumping is kept adjusted in such a manner that the cutting edge (10) as well as the bottom spikes (11) remained in the slurry all the time.

(vi) After the positioning of the box (8) the tremie pipes (12) are lowered for concreting to form a composite concrete section (13).

With reference to figure 2 (2A,2B) the slurry cum lining trench process is described as below.

The trench operation is performed by a suitable mechanical excavator (5) employing the bentonite slurry technique, incorporating simultaneously a stabilized sand lining involving operation of gun (14) and nozzle fitted with non return solenoid operated valve (7). Dry sand is forced with the help of air motor (15) running at various speeds and producing desirable pressures roughly of magnitude 50 psi and 60 psi in blow out a jet of sand (16). Due to the characteristics of the nozzle and the valve (7) dry sand particles are ejected centrifugally into the bentonite slurry. Therefore the bentonite slurry is disturbed and instantaneously a sol state is created because of relatively weaker electric bonds, during which the non charged dry sand particles such free water liberated due to breakage of dipole water and land on the barrier whence the mechanical force gets destroyed and due to predominant electrical forces a state of much higher strength is achieved because of entrapped sand particles creating a stabilized linging (17) on the trench sides.

With reference to figure 3 (3A, 3B, 3C) the mechanism of the tensegrity structural box is described as below:-

A configuration as depicted in figure 3 is accomplished from the principles that in tension the strength is relatively unlimited since the loads gets distributed throughout all dimensions permitting the loads to be applied at any point. The structural frame (18) consists of a system of tetrahedrons formed from steel bars. The high tensile wires (19) radiating fromthe hub member (20) joining the columnar frame (18) is designed to produce tensional stresses in the entire frame when subjected to tensioning through standard nut system(21). (The nut system shown is only illustrative) when the high tension wires (19) are tensioned by means of nut system (21) the tension is induced in the tetrahedral frame (18) and hub member (20) while the compression in the connecting wires (23). The connecting wires are ordinary steel wires of the same length as tension wires joined to the rod (24) of the same length as hub (20) but without flange (25). The structural frame (18) is cladded by high sectional modulus corrugated sheeting in wave form to transmit the external loads to the frame. When the compressive forces from the sides act on the box it is resisted by the pretensioned frame (18) and hub member (20). When the concreting is performed tensional stresses in the steel bars induce the compressive stresses in the concrete producing a composite prestressed concrete section(13).

Figure 4 (4A,4B) the configuration of the entic panel length is shown in plan and sectional elevation to project the full arrangements of the steel bars and high tensile wires. This amplifies the description

of the operation and mechanism presented earlier.
Figure 5(5A, 5B, 5C, 5D) explains the joining system the working of tetrahedran unit, and tensioning system. The joining system consists of a hub (20) with a flange (25) having oblong holes (26) in which the high tensile wires (19) of enlarged heads are hooked. The tetrahedron unit represents a nonredundant, a basic discontinuous compression and continuous tension structure. It is consisted of T-Flange (27) joined by connecting bars (28) to form a cube in which run the radial bars (29) from the C G of the cube. The tensioning system (21) as illustrated is the standard nut system It consists of a flanged nut (30) and is tightened on the threads of the high tension wires (19) through T member (28).

Figure 6 (6A, 6B) illustrates the mode of instrumentation schematically.

The instrumentation is to be provided in the pipe (31) and hub (20) at suitable intervals. It consists of standard straingauge arrangements (32) to be led to strain indicator (33) through channel switch and balance box unit.
