United States
Department of
Agriculture

Soil
Conservation
Service

693 Federal Building
210 Walnut Street
Des Moines, IA 50309

March 26, 1987

ENGINEERING FIELD MANUAL
IA210-ENG-AMENDMENT IA31, CHAPTER 6

Purpose. To transmit pages IA6-26 (1 thru 7)

Effective Date. This amendment is effective upon receipt.

Filing Instructions. This amendment should be filed immediately following page 6-26 in the EFM.

This amendment adds information on the concrete block chute spillway which may be used to control overfalls or abrupt changes in waterway grade. Drop through the structure is limited to 10 feet with maximum design flow limited to 200 cfs. Iowa Standard Drawing 802 has been developed for use in planning concrete block chute structures.

Each copy of the EFM should have these pages. Additional copies may be ordered from the State Office. This transmittal may be destroyed when it has been documented on the directive tabulation sheet and the material has been filed.

Herschel R Reed, acting

J. Michael Nethery
State Conservationist

Attachments

A
F
EN3
MNTC - 5
DSC-2 (Krishan, Lindquist)
SCE - Midwest States

CONCRETE BLOCK CHUTE SPILLWAY

DESCRIPTION

The concrete block chute spillway is a spillway with its flow area lined with precast concrete building blocks or modular concrete pavers placed on filter fabric. The earth subgrade is shaped to the lines and grade of the structure and covered with filter fabric on which concrete blocks are placed. The openings in the blocks are filled with loose, friable soil and seeded to a sod-forming grass.

MATERIALS

The inlet, outlet, bottom, and side slopes of the chute are lined with modular blocks made of precast concrete. Modular units have openings or cells that extend the depth of the unit. They are sold as building blocks and under a number of product names as shown in Table 1. Concrete building blocks and Monoslabs are manufactured in Iowa and are the basis of this procedure. Other brands of paver could be used by adjusting the structure dimensions. Illinois has had good success using concrete building blocks. Filter fabric lines the inlet, outlet, bottom and side slopes of the chute under the concrete blocks.

Cutoff walls may be cast-in-place concrete; precast concrete panels; 16 gage galvanized, smooth or corrugated steel sheets; or sheet plastic with a minimum 6 mil thickness.

FUNCTIONAL USE

The concrete block chute may be used to control overfalls or abrupt changes in grade of a natural or constructed waterway; prevent erosion at the ends of waterways; lower water over drainage ditchbanks; and conduct water from an adjacent flat area to the bottom of a ditch.

ADAPTABILITY

The concrete block chute is adapted to small watersheds and sites where dense sod can be developed and maintained. The watercourse downstream of the chute must be stable.

ADVANTAGES

The spillway is easy to construct. It can be installed by inexperienced labor and the cost is relatively low.

LIMITATIONS

This structure is limited to sites that are well drained, have good soil, and no long, sustained flow. **It cannot be used as a water-impounding structure.** Its life expectancy is not as long as other permanent structures. Particular care must be taken in the design, layout, construction, and maintenance.

DESIGN

Criteria for the concrete block chute are fashioned after the formless concrete chute and sod chute structures. Final dimensions are based upon model studies in Illinois and field observations in Illinois (over 50 sites) and Iowa (17 sites).

Chute widths will normally be less than the upstream waterway width. The last 50 feet or less of the waterway may be used for a transition section to change the bottom width and/or side slopes of the waterway to match the chute inlet dimensions. Dikes may be required to ensure that the design flow is directed to the structure. The height of the dike and/or sides of the inlet section of the chute should provide 1.0 foot of freeboard above the depth of flow in the waterway.

Aprons at the inlet and outlet should have a minimum length of 4 feet. Apron lengths on the standard drawing should be given in feet to correspond to the number of rows of blocks used. (The number of rows can also be shown in parentheses.) Blocks should protect the side slopes of the inlet section for the depth of flow in the waterway. The drop through the structure is limited to 10 feet.

For stability and ease of construction, chute side slopes should be no steeper than 1:1. A minimum of one row of blocks should be used. The blocks should protect the slope for at least the design depth of flow; six inches of freeboard would be desirable. Side slopes should be shaped to 2:1 or flatter above the last row of blocks to facilitate the establishment of grass cover.

Cutoff walls should be placed both upstream and downstream. The upstream cutoff helps prevent water from flowing under the blocks and the downstream cutoff helps prevent sliding of the blocks. The cutoff wall shall extend a minimum of 2 feet below the subgrade of the chute.

Cast-in-place cutoff walls shall have a minimum thickness of 6 inches. Ready mixed, air entrained concrete puchased from commercial mixing plants is acceptable. Precast concrete panels shall have minimum dimensions of 2 feet x 2 feet x 2 inches thick. Sheet plastic cutoffs should be placed with the top flush with the chute subgrade. Other types of cutoff should be placed with the top flush with the upper face of the adjacent blocks.

Subgrade beneath the concrete blocks shall be completely covered with filter fabric. Filter fabric should be ultraviolet (UV) resistant with an equivalent opening size (E.O.S.) greater than 60, burst strength greater than 200 psi, and tear strength greater than 50 lbs. (Trevira Spunbond 1120 or equal).

Type of soil, volume of runoff, and chute flow velocity must be considered when designing a chute. Chute slopes of 3:1 and 4:1 are acceptable if the chute is located all on cut and flows are low. Slopes of 6:1 or flatter should be used on non-cohesive soils and sites where the chute is placed partially or entirely on compacted fill. Velocities should be limited to 10 feet per second for cohesive soils and 6 feet per second for non-cohesive soils. Illinois has had good results with chutes placed on a 3:1 slope. The steepest slope used in Iowa to date is 4:1.

(EFM, Amend. IA31, March 1987)

The following table is based on a Manning's "n" value of 0.040 and 1:1 side slopes. It may be used to determine minimum chute dimensions.

MINIMUM CHUTE BOTTOM WIDTH - Feet

Chute Slope, %	10 (10:1)			12.5 (8:1)			16.7 (6:1)		
Max. Velocity, fps	6	8	10	6	8	10	6	8	10
Max. Flow Depth, ft.	0.4	0.6	0.9	0.3	0.5	0.8	0.3	0.4	0.6
Peak Runoff, cfs.									
30	14	10	10	16	10	10	20	10	10
35	16	10	10	18	10	10	24	10	10
40	18	10	10	22	10	10	26	12	10
45	20	10	10	24	10	10	30	14	10
50	22	10	10	26	12	10	34	16	10
60	26	12	10	32	14	10	40	18	10
70	32	14	10	38	18	10	46	22	12
80	36	16	10	42	20	10	54	26	14
90	40	18	10	48	22	12	60	28	16
100	46	22	10	54	26	14	66	32	18
120	54	26	14	64	30	16	80	38	22
140	64	30	16	76	36	20	94	46	26
160	72	34	18	86	42	22	108	52	28
180	82	38	22	96	46	26	120	58	32
200	90	44	24	108	52	28	134	64	36

Chute Slope, %	20 (5:1)			25 (4:1)			33 (3:1)		
Max. Velocity, fps	6	8	10	6	8	10	6	8	10
Max. Flow Depth, ft.	0.2	0.4	0.5	0.2	0.3	0.4	0.2	0.2	0.3
Peak Runoff, cfs.									
30	22	10	10	28	12	10	33	16	10
35	26	12	10	32	16	10	39	18	10
40	30	14	10	36	18	10	44	21	12
45	34	16	10	40	20	10	50	24	13
50	38	18	10	46	22	12	55	27	15
60	46	22	12	54	26	14	67	32	18
70	54	26	14	64	30	18	78	37	21
80	62	30	16	72	36	20	89	43	24
90	68	34	18	82	40	22	100	48	27
100	76	36	20	90	44	24	111	54	30
120	92	44	24	108	52	30	134	65	36
140	108	52	30	128	62	34	156	76	43
160	122	60	34	146	70	40	178	86	49
180	138	66	38	164	80	44	201	97	55
200	154	74	42	182	88	50	223	108	61

The grade downstream of the structure must be stable. Excessive scour can occur immediately downstream of the chute if sufficient tailwater is not provided. Tailwater depth should equal or exceed the depth of flow in the upstream waterway. The outlet apron should be placed below channel grade, if necessary, to provide additional needed tailwater depth.

The final selection of chute dimensions and slope must balance chute width and slope with cost after considering specific site conditions such as soils, allowable velocity, and ease of construction.

CONSTRUCTION

Excavation begins at the downstream cutoff and apron, proceeds up the chute slope, and ends at the inlet apron and cutoff. Subgrade alignment and grade are referenced to offset stakes.

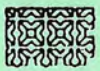
Once excavation is completed, filter fabric is placed over the subgrade and down into the cutoff trenches where it is anchored. The cutoffs are then installed and backfilled with compacted earth fill. Filter fabric shall have a minimum overlap of 1.0 foot where two pieces are joined. It is important that cutoff and filter fabric extend to the full width of the blocks laid.

All areas of the structure will then be covered with concrete blocks placed tightly together with the holes up. Monoslabs will be placed with the long axis perpendicular to the direction of flow. Concrete building blocks will be placed with the long axis parallel to the direction of flow except on the side slopes where they are placed perpendicular to the flow.

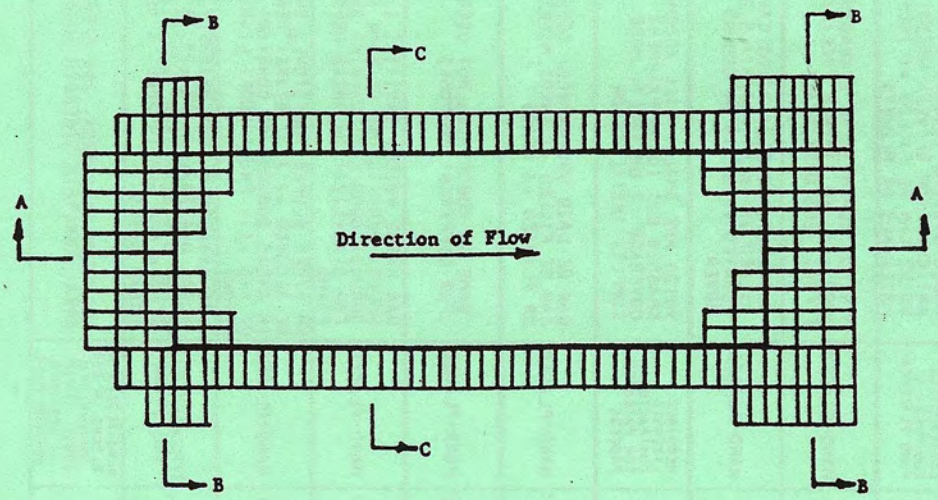
The triangular void areas at the joints between the inlet apron, chute slope, and side slopes may be grouted using a mixture of 3 parts sand to 1 part cement. Bagged mortar mix may also be used. Adding a capfull of liquid detergent to the grout slurry aids in placement.

Holes in the concrete blocks shall be filled with loose, friable soil suitable for a seedbed. The entire disturbed area should then be seeded.

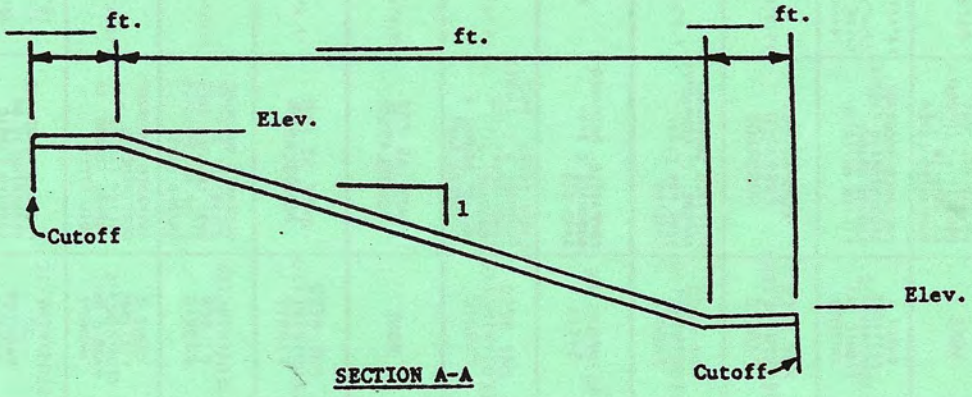
TABLE I
MODULAR PAVING UNITS FOR EROSION CONTROL

PRODUCT NAMES (See notes below)	RECOMMENDED USES	MATERIAL	AVAILABLE FORMS	SHAPES & PATTERNS	OTHER COMPONENTS NEEDED FOR INSTALLATION	FOUNDATION REQUIREMENTS	UNIT DIMENSIONS	INSTALLATION METHOD	REMARKS
1. HASTINGS CHECKER BLOCKS ®	STABILIZATION ALONG STREAMS AND LAKE BANKS; ROAD SHOULDERS & SERVICE RDS.; SLOPES	PRECAST CONCRETE	OPEN CELLS; WAFFLE PATTERN		NONE	UNDISTURBED EARTH OR FILL COMPACTED TO 95% MAX. DRY DENSITY w/ TOPSOIL OR SAND IN A 2" COMPACTED LAYER	24"x24"x4"	HAND-PLACED	NOT SUITABLE FOR INTENSE WAVE ACTION; VOIDS CAN BE FILLED AND PLANTED
2. ARMORFLEX	COASTAL SHORELINES, LAKES, RIVERS, STREAMS, EMBANKMENTS, SLOPES	PRECAST CONCRETE BLOCKS INTERCONNECTED INTO MATS	OPEN CELLS; CLOSED CELLS; ALL CELLS INTERLOCK		CABLE & FITTINGS GEOSYNTHETIC FABRIC MAT ANCHORS	PREPARED SUBGRADE; GEOSYNTHETIC FABRIC AND/OR GRADED FILTER MATERIAL	13"x11.6"x4.75" to 17.4"x15.5"x9" (with interned. dimensions)	CONVENTIONAL CONSTRUCTION EQUIPMENT & HAND PLACEMENT	CAN BE INSTALLED UNDERWATER; CABLE SYSTEMS INSURES ARTICULATION BETWEEN GRIDS; VOIDS CAN BE FILLED w/ INERT MATERIALS OR PLANTED
3. ARMORLOC	STABILIZATION ALONG STREAMS, LAKE BANKS & EMBANKMENTS	PRECAST CONCRETE	OPEN CELLS; CELLS INTERLOCK		MAY NEED GEOSYNTHETIC FABRIC	COMPACTED, PREPARED SUBGRADE	15.8"x11.9"x4"	HAND-PLACED	MINIMUM COMPRESSIVE STRENGTH-4000 psi, NO VISIBLE FREEZE/THAW EFFECT, 25% OPEN SPACE
4. GOBIBLOCK ®	STABILIZATION ALONG STREAMS & LAKE BANKS; STEEP SLOPES; EMBANKMENTS	PRECAST CONCRETE	OPEN CELLS; w/ COBBLED SURFACE		MAY NEED GEOSYNTHETIC FABRIC	PREPARED SUBGRADE; APPROX. 1" COMPACTED SAND FOR LIGHT LOADING	7.9"x7.9"x3.9"	HAND-PLACED	HIGHLY PERMEABLE; VOIDS CAN BE FILLED w/ INERT MATERIALS OR PLANTED w/ GRASS OR GROUND COVER
5. GRASSCRETE ®	STABILIZATION ALONG STREAMS & WATERWAYS; STEEP SLOPES; EMBANKMENTS	POURED-IN-PLACE CONCRETE	PROPRIETARY FORMERS w/ "X" VOIDS		REINFORCING STEEL	COMPACTED, PREPARED SUBGRADE & 3/4" SAND BED	N/A	REQUIRES LICENSED CONTRACTOR FOR PATENTED PROCESS	VOIDS ARE SMALL; WILL ACCOMODATE GRASSES BUT TOTAL PAVEMENT COVERAGE IS UNLIKELY; MORE COMPLEX INSTALLATION
6. MONOSLABS ®	STABILIZING STEEP SLOPES; DIKES & EMBANK. (45°); WATERWAY BEDS & SLOPES; SHORELINES	PRECAST CONCRETE	OPEN CELLS; WAFFLE PATTERN		MAY NEED GEOSYNTHETIC FABRIC	LIGHT LOADS - PREP. SUBGRADE & 1" TAMPED SAND; HEAVY LOAD - SUBGRADE, 6" BALLAST COURSE & 1" TAMPED SAND	24"x16"x4.6"	HAND-PLACED	CAN BE LAID UNDERWATER; VOIDS CAN BE FILLED w/ INERT MATERIALS OR PLANTED w/ GRASS
7. GRASS PAVERS ®	TURF REINFORCER FOR ERODING ROADSIDES; PATHS; STABILIZATION ON MODERATE SLOPES	PRECAST CONCRETE	OPEN CELLS; CASTELLATED CHECKERBOARD		NONE	SAME AS FOR MONOSLABS®	23.5"x15.6"x4.6"	HAND-PLACED	SAME AS MONOSLABS® BUT USED FOR DIFFERENT PURPOSES
8. AMBIGRID™	STABILIZATION ALONG STREAMS; WATERWAYS; STEEP SLOPES; DIKES; EMBANK.	PRECAST CONCRETE	OPEN CELLS; CELLS INTERLOCK		MAY NEED GEOSYNTHETIC FABRIC	SAME AS FOR MONOSLABS®	17.3"x11.5"x5"	HAND-PLACED	HAS LARGE VOIDS, CAVITIES & BASE HOLES; PERMITS USE OF SOME SMALL SHRUBS; GOOD FLAT WALKING SURFACE FOR STABILIZATION AREAS USED AS PATHS
9. TURFSTONE ®	EROSION CONTROL ON EMBANKMENTS, EARTH BERMS, SWALES, STEEP SLOPES	PRECAST PORTLAND CEMENT	OPEN CELLS		GEOSYNTHETIC FILTER FABRIC	PREPARED SUBGRADE; 3"-16" OF 3/4" OR 5/8" CRUSHED ROCK; 2" OF UNCOMPACTED GRADED SAND	23.6"x15.6"x3.6"	HAND-PLACED	ON STEEP SLOPES TURFSTONE® SHOULD BE SECURED w/ A 2" STAKE; PERFORMS IN AREAS SUBJECT TO CONSTANT FLOWS OF <10 cfs; FROSTPROOF; LIGHT WEIGHT
10. PETRAFLEX™ (BLOCK H-512)	STABILIZATION OF SHORELINES, RIVERS, BEACHHOS., BOAT RAMPS, WATER-COURSE LINING, CULVERT DISCHRG., & RIVER EMBANK.	PRECAST CONCRETE	OPEN CELLS		CABLE & FITTINGS GEOSYNTHETIC FABRIC MAT ANCHORS	PREPARED SUBGRADE; GEOSYNTHETIC FILTER FABRIC (SPEC. ACCORD. TO SOIL TYPE)	11.9"x11.9"x5"	SPREADER BAR AND CRANE	ALSO AVAILABLE FROM PETRAFLEX: -BLOCK H-41224; 11.75"x23.75"x4.5" -BLOCK H-91824; 17.9"x23.75"x8" -BLOCKS FOR ARCTIC APPL. & HEAVY OCEAN WAVES
11. TRI-LOCK	REVETMENT FOR SHORE PROTECT., BEACHHOS., BOAT RAMPS, WATERCOURSE LININGS, CULVERT DISCHRG., & RIVER EMBANK.	PRECAST CONCRETE	TWO COMPONENTS; LOCK BLOCK & KEY BLOCK; OPEN CELLS		GEOSYNTHETIC OR CARRIER FABRIC	PREPARED SUBGRADE; GEOSYNTHETIC OR CARRIER FABRIC	16" MODULE 4"-6" THICK OR 32" MODULE 8"-12" THICK	HAND-PLACED AS BLOCKS OR USE CONVENTIONAL CONST. EQUIP. w/ SPREADER BAR FOR MATS	BLOCKS HAVE APPROX. 20% OPEN AREA; CONCRETE STRENGTH 3000 psi

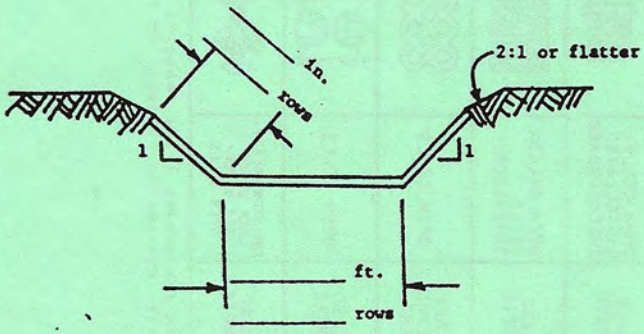
Notes: 1. Product guide information containing trade names is used to present concepts and information only.
2. No endorsement of products, equipment, vendors, or consultants is intended nor is criticism implied of those not mentioned.



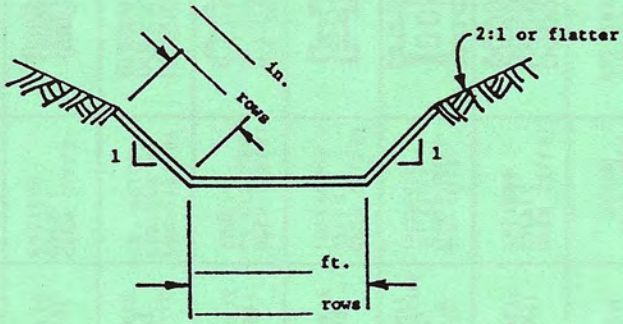
PLAN



SECTION A-A



SECTION B-B



SECTION C-C

Owner _____

Location _____ Sec ___ T ___ N, R ___ W

_____ County, Iowa

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

IOWA STANDARD DRAWING	
CONCRETE BLOCK CHUTE SPILLWAY	
STANDARD DRAWING NO. 802	
DATE 3-87	SHEET 1 of 2

Designed ..... Date ..... Approved by ..... Title .....
Drawn ..... Title .....
Traced ..... Sheet No. ..... of ..... Drawing No. —
Checked .....

(EFM, Amend. IA31, March 1987)

CONSTRUCTION NOTES

1. Cutoff walls may be cast-in-place concrete; precast concrete panels; 16 gage galvanized, smooth or corrugated steel sheets; or sheet plastic with a minimum 6 mil thickness. The cutoff wall shall extend a minimum of 2 feet below design subgrade of the chute. Cast-in-place concrete cutoff walls shall have a minimum thickness of 6 inches. Precast concrete panels shall have minimum dimensions of 2 feet x 2 feet x 2 inches thick. Sheet plastic cutoffs shall be placed with the top flush with the chute subgrade. Other types of cutoff shall be placed with the top flush with the upper face of the adjacent blocks.

2. Subgrade beneath the concrete blocks shall be completely covered with filter fabric. Filter fabric shall be UV resistant with an equivalent opening size (E.O.S.) greater than 60, burst strength greater than 200 psi, and tear strength greater than 50 lbs. (Trevira Spunbond 1120 or equal). Filter fabric shall be anchored at the bottom of the cutoff walls. Filter fabric shall have a minimum overlap of 1.0 foot where two pieces are joined. Cutoffs and filter fabric must extend to the full width of the blocks laid.

3. Concrete pavers shall be placed with the long axis perpendicular to the direction of water flow. Concrete building blocks will be placed with the long axis parallel to the direction of flow except on the side slopes where they are to be placed perpendicular to the flow. Side slopes shall be protected by concrete blocks for at least the depth of flow. Side slopes shall be 1:1 or flatter. Construction shall start at the outlet and proceed upstream.

4. The triangular void areas at the joints between the inlet apron, chute slope, and side slopes may be grouted using a mixture of 3 parts sand to 1 part cement. Bagged mortar mix may also be used. Adding a capful of liquid detergent to the grout slurry aids in placement.

5. The last 50 feet or less of the waterway may be used for a transition section to change the bottom width and/or side slopes of the waterway to match the chute inlet dimensions. Dikes may be required to ensure that the design flow is directed to the structure.

6. The chute shall be built to the lines, grades, and dimensions shown on this drawing.

7. Openings in concrete blocks shall be filled with loose, friable soil suitable for a seedbed.

DESIGN DATA	
Drainage Area, Acres	
Peak Runoff, cfs.	
Waterway Flow Depth, ft.	
Chute Flow Depth, ft.	
Chute Slope Ratio	
Side Slope Ratio	
Bottom or Chute Length, ft.	
Bottom or Chute Width, ft.	
Upstream Apron Length, ft.	
Downstream Apron Length, ft.	
Depth of Cutoff Walls, ft.	

BILL OF MATERIALS

_____ ea. Concrete Blocks

_____ sq. yd. Filter Fabric

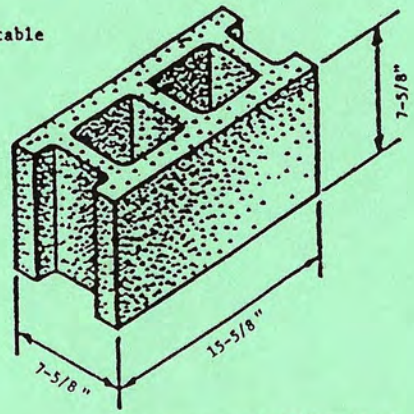
_____ cu. yd. Concrete

_____ ea. Precast Concrete Panels, 2' x 2' x 2"

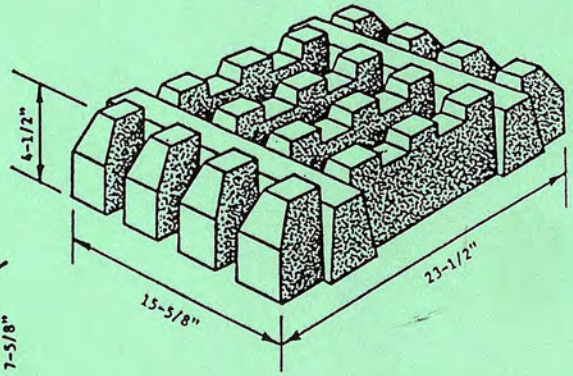
_____ sq. ft. 16 ga. Galvanized, Smooth or Corrugated Steel

_____ sq. ft. Sheet Plastic, _____ mil thickness

BENCH MARK _____



TYPICAL CONCRETE BUILDING BLOCK



TYPICAL CONCRETE PAVER BLOCK (MONOSLAB)

IOWA STD DWG. NO. 802
Sheet 2 of 2