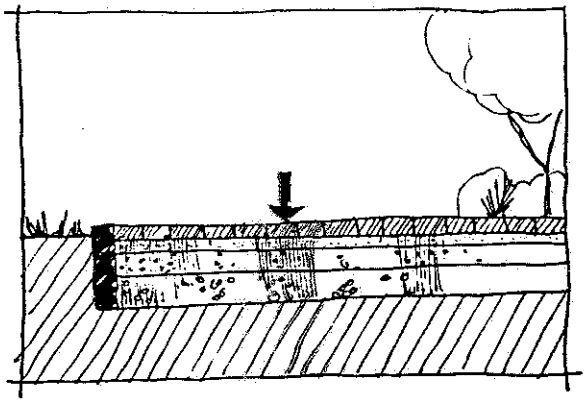
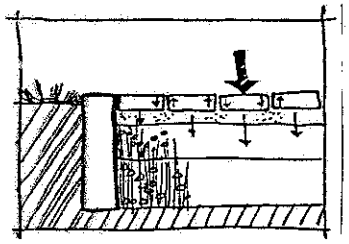


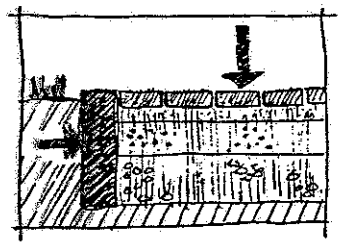
Structural Principles

The successful transferral of any vertical load through a segmentally paved area requires the incorporation of three principles. These principles must be utilized when installing open grid as well as solid interlocking pavers. It is also important to note that all three principles in this section are equally important, however, they have been described in a hierarchy that is sensitive to the design process.



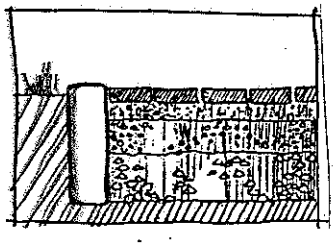
Continuous/Contiguous

Describes the necessity of the pavers to be adjacent to each other for successful load transferral.



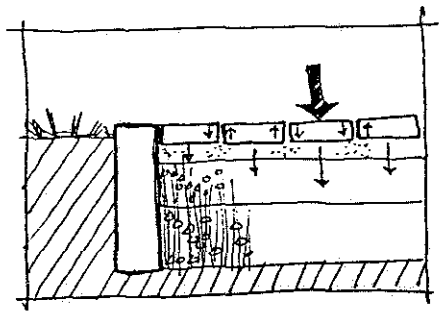
Edge Restraint

Descrides the need to contain the paved area for the proper development of horizontal forces.



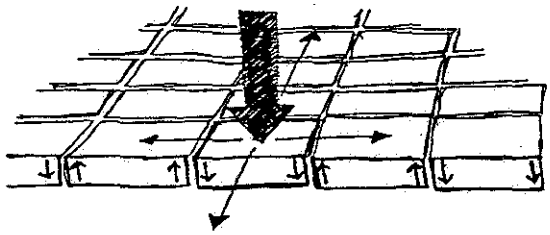
Five Layers

Describes the preparation of the base for the various load applications.



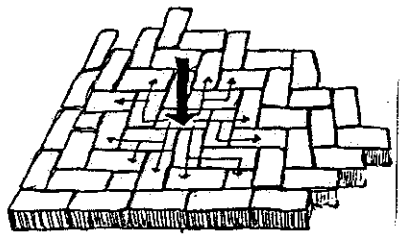
Continuous/Contiguous

Vertical loads are transferred through an assembly of units throught the development shear between the units. When the units are placed next to each other in a tight arrangement, friction between the units is developed thereby mobilizing a large portion of the paved plane for load resistance. In order to develop the friction which develops the shear, the units must be continuous and contiguous within an arrangement. The interlocking nature of the concrete pavers by default results in a continuous and contiguous assembly, however, it is good practice to follow the two basic rules below when designing a segmentally paved surface;



CONTINUITY OF FACES

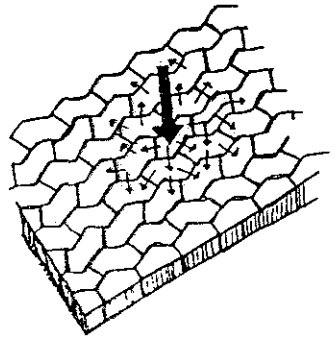
At a minimum, the two opposite faces of a surface of concrete pavers must be contiguous. This will result in load transferring in basically one direction and is acceptable for linear arrangements under light loading conditions. For higher load carrying capacity, continuity in more than one direction is necessary. This arrangement will transfer loads to all of the neighboring units much like a space frame building system.



DISCONTINUITY OF LINES OF ACTION

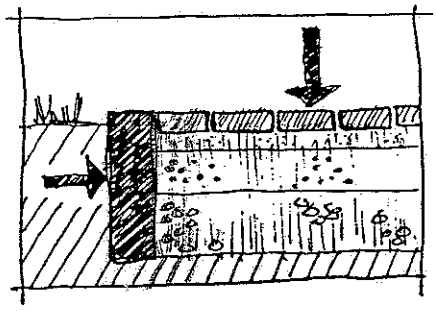
COMPLEXITY IN PATTERN DESIGN

Mobilization of large areas of the paved surface under load is directly related to the ability of the individual unit under load to transfer the shear to as many neighboring units as possible. Discontinuity of lines of structural action can be continually transfered from a unit in one direction to a unit in another direction through complexity in the laying pattern, such as 90 or 45 degree herringbone.



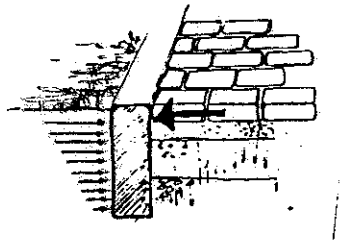
COMPLEXITY IN UNIT DESIGN

Increased shear and discontinuity of action lines can also be achieved through a complex interlocking shape, such as the dentated unit. The complex shaped units offer several paths for loads to travel thereby involving a large paved area for resisting loads.



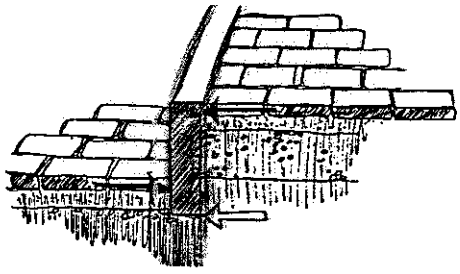
Edge Restraint

In order to develop the friction between neighboring units, the units within a paved surface must be restrained from drifting away from one another. This is accomplished through the use of edge restraints that keep the pavers in a contiguous arrangement. It is ideal to have all of the edges of a paved surface restrained as this will result in load transferring in more than a single direction. The restaint can occur in a variety of ways and will fall under one of the following generic types;



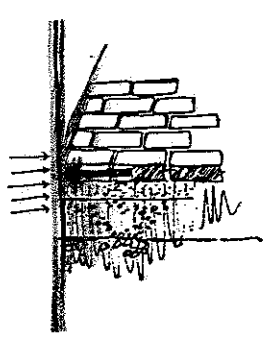
PAVED TO UNPAVED

To develop sufficient restraint at an unpaved border, the edge must penetrate the earth to a depth that will force the adjacent ground to act as a berm. This is typically accomplished through the use of a curb of pavers on end, a continuous metal strip or a continuous, poured concrete strip.



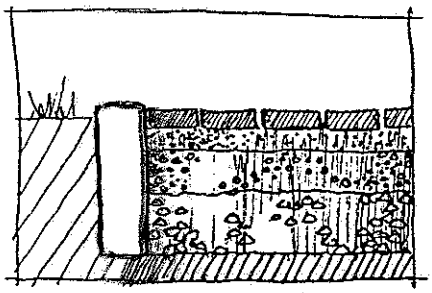
PAVED TO PAVED AT DIFFERENT LEVELS

In this scenario, the force offered by the edge restraining must be transferred from one level to another. This is best accomplished through a gentle curving of the units from one level to another or the use of a curb for abrupt changes in level. The curb for the abrupt changes must be stiff enough and deep enough to resist any rotation due to the lateral forces induced by the adjacent paved surface at different levels.



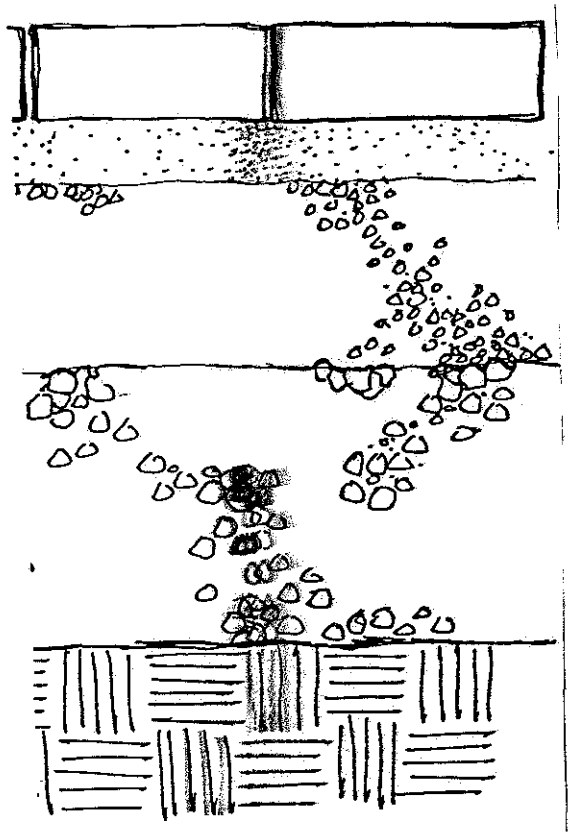
PAVED TO BUILDING MASS

When paving up to a building, edge restraint occurs naturally at the vertical walls of the building. At this junction, pavers must conform to the shape of the building at the pavement level and the lateral force developed within the plane of the paved surface will be resisted by the building mass.



Five Layers

The preparation of the base is the final element in the succesful load carrying capacity of concrete pavers. Although this is not a visible "design" element it is an important general principle that must be considered during initial conceptual design phases. The previous two principles deal primarily with the surface layer which is the top layer of the five total. The remaining four exist below the surface of the pavers.



PAVED SURFACE

Sand or spacers between units to develop shear (friction) between units.

SAND BASE

Leveling bed, even distribution of load to base through the use of a consistent, level surface.

BASE

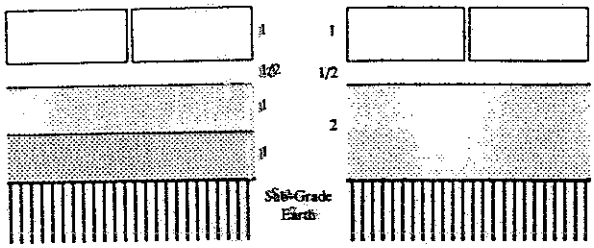
Leveling and distribution of load to subbase. Smaller particles prevent the sand from seeping into it. Base materials are compacted to increased their load bearing capacity.

SUB-BASE

Well compacted and sometimes made of larger aggregate for overall stability on soft wet soils. Depth depends on quality of soil and load bearing capacity. Sometimes the sub-base is omitted and its absence is compensated by a thickened base.

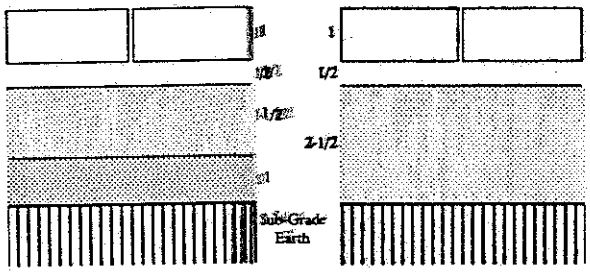
SUB-GRADE EARTH

The natural load bearing capacity of the existing earth at the site must be sufficient to endure the loads placed upon the pavement, sand and base. The sub-grade earth is often compacted prior to the installation of the layers above. For weaker soils, the stronger base and sub-base materials disperse the loads across the soil to minimize deformation.



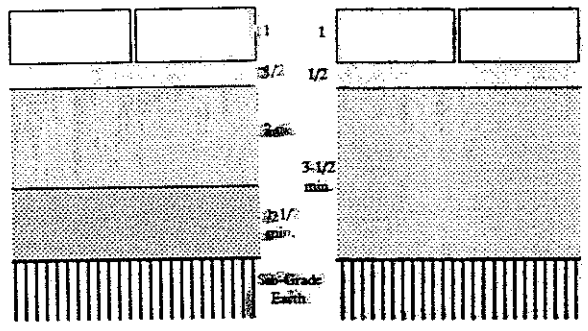
PEDESTRIAN OR LIGHT VEHICULAR LOADS

For light loads on normal soils, the cross section of the layers are proportioned as 1:1/2:1:1. That is; the unit thickness at the paver level, 1/2 the unit thickness in sand, the unit thickness in aggregate, and the unit thickness of compacted aggregate in contact with the earth. For intermediate loads on strong soils the thickness of the unit can be increased and inturn the layers below can be proportionally increased. The overall cross section composition results in a depth of approximately 8" to 10" (20cm to 25cm).



INTERMEDIATE VEHICULAR LOADS

For intermediate loads and normal soils, the cross section is increased in the dimension of the base material and typically the thicker paver of 3.125 (80cm) is used. The added thickness will enhance the load distribution to the sub-grade earth improving overall performance and stability. Note that the base and sub-base materials can be replaced by a single base with an overall proportion of 2-1/2 times the unit thickness. The final composition of this applicationis approximately 12" in total depth (30.5cm).



HEAVY LOADS OR WEAK SOILS

For very heavy loads on normal or good soil, the cross section of the layers will vary basically only in the thickness of the paving units and the depth of the base and sub-base. By increasing the depth of the unit and base material, more shear force will be developed between units and in the aggregate of the base. This additional shear will mobilize units and material further away from the load therefore reducing the overall stress on the earth below. The proportions of the layers are 1:1/2:2 (minimum):1-1/2 (minimum). In some cases the base and sub-base compositions are combined into one layer that may be treated with cement resulting in a total thickness of stabilized base and sub-base of about seven times the thickness of the unit. The overall final composition of this application ranges from 15" to 28" in depth (38cm to 71cm).