6.2 *EFFECTIVE WIDTH*

The effective width (d) of a soldier pile is generally considered to be the dimension of the soldier pile taken parallel to the line of the wall for driven piles or drilled piles backfilled with material other than concrete. The effective width of the soldier piles may be taken as the diameter of the drilled-hole when 4-sack or better concrete is used. Soil arching however, can greatly increase the effective width described above. See Figure 6-9. Arching of the soil between soldier piles can increase the effective width of a soldier pile up to 3 times for granular soil and 2 times for cohesive soils.

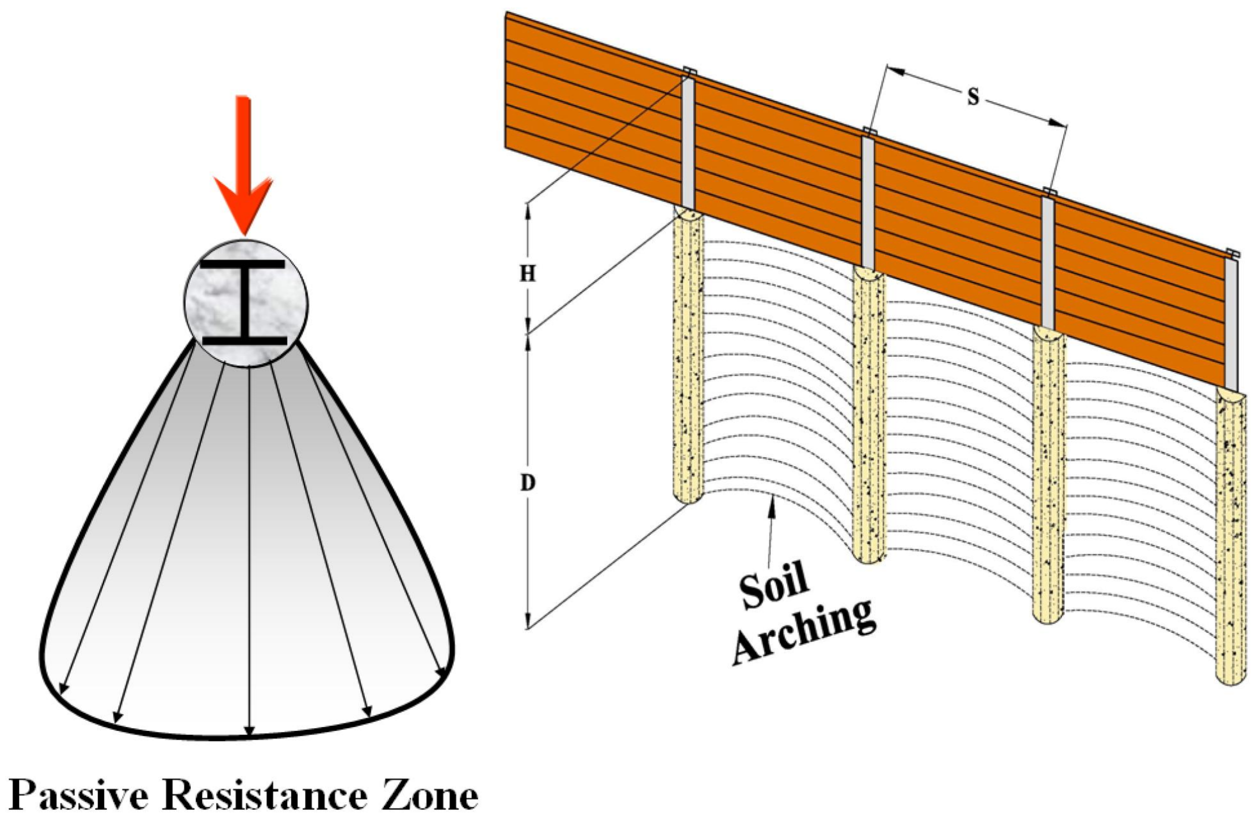

Figure 6-9. Soldier Pile with Arching

Numerous full-scale pile experiments have shown the passive resistance in front of an isolated pile is a three dimensional problem as shown in Figure 6-9. Two dimensional classical earth pressure theories under estimates the passive resistance in front of a soldier pile. Therefore, the passive resistance in front of a pile calculated by classical earth pressure theories shall be multiplied by the

5.3 *OVERSTRESS*

Short term increases to allowable stresses are allowed (to a maximum of 133%) except in the following situations when:

1. Excavations are in place more than 90 days.
2. Dynamic loadings are present (pile driving, traffic, etc).
3. Excavations are adjacent to railroads.
4. Analyzing horizontal struts.

5.4 *LAGGING*

Lagging is placed between the flanges of either wide flange (W) or HP piles. The practice of installing lagging behind the back flange of the soldier piling is not recommended because the potential arching action of the supported soil will be destroyed. Also, the unsupported length of the compression flange of the beam will be affected. Lagging placed behind the front flange may be wedged back to provide tight soil to lagging contact. Voids behind lagging should be filled with compacted material. Lagging may be installed with a maximum spacing up to 1½ inches between lagging members to permit seepage through the wall system. Movement of soil through the lagging spaces can be prevented by placing or packing straw, hay or similar material into the spaces. Filter fabric behind the lagging members is usually used for permanent structures.

The lagging bridges and retains soil between piles and transfers the lateral soil load to the soldier pile system. Due to the flexibility of the lagging and the soil arching capability, as shown in Figure 5-1, multiplying the maximum earth pressure by a reduction factor of 0.6 reduces the soil pressure distribution behind the lagging.

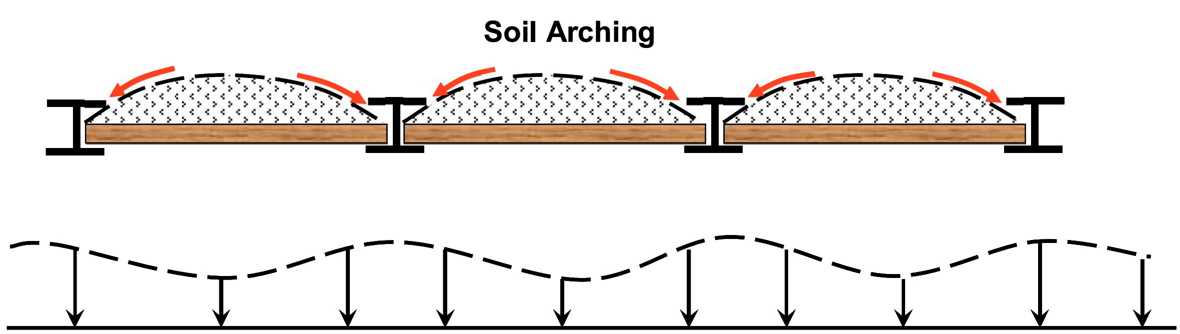

Figure 5-1. Soil Arching

Construction grade lumber is the most common material used for lagging. Treated lumber is beneficial to use when it is expected that the lagging will remain in place for a long period of time, or permanently. If the use of treated lumber is proposed, check to see that it complies with your contract and permit requirements, especially in and near water sources.

Lateral soil movement within the failure wedge induces soil arching behind lagging. This soil movement causes the lagging to flex outward. The arching process induces a redistribution of soil pressure away from the center of the lagging toward the much stiffer soldier pile support. Because of this, the design load on the lagging may be taken as 0.6 times the theoretical or calculated earth pressure. Studies have shown that a maximum lagging pressure of 400 psf should be expected when surcharges are not affecting the system. Without soil arching, the pressure redistribution would not occur and reduced lagging loads should not be considered. For the arching effect to occur the backside of the soldier pile must bear against the soil.

- Lagging design load = 0.6 (shoring design load).
- Maximum lagging load may be 400 psf without surcharges.

Table 5-2 lists FHWA recommended minimum timber thickness for construction grade Douglas Fir lagging for the following soil classifications.

- <u>Competent Soils:</u> These soils include high internal friction angle sand or granular material or stiff to very stiff clays.
- <u>Difficult Soils:</u> These soils consist of loose to low internal friction angle cohesionless material, silty sands, and over consolidated clays which may expand laterally, especially in deep excavations.
- <u>Potentially Dangerous Soils:</u> The use of lagging with potentially dangerous soils is questionable.

The tabular values may be used for lagging where soil arching behind the lagging can develop. Tabular values should not be used for excavations adjacent to existing facilities including railroads. Lagging used in conjunction with surcharges should be analyzed separately.