masterSERIES

Technical Note

Title: MasterSeries Base Plate Washer Embedment and Bending Design

Date: 08/04/2022

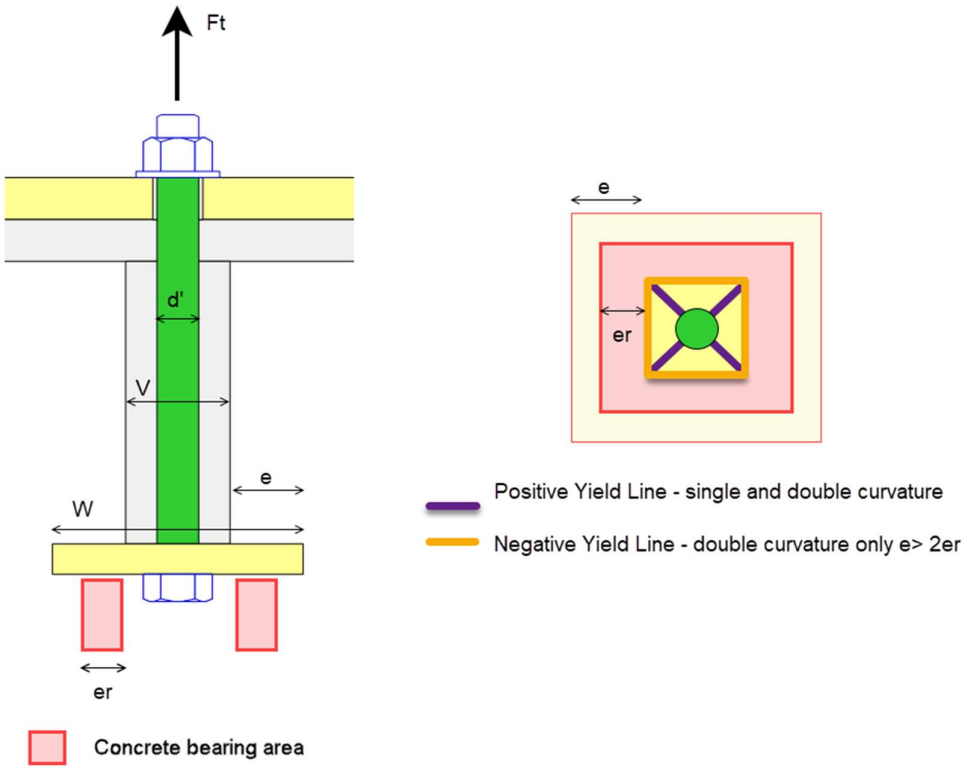
Versions: 2021.16 +

Program: MasterKey Connections Design

MasterSeries Base Plate Washer Embedment and Bending Design

MasterSeries design of the base plate holding down bolt washers assumes a lack of imperfect grouting at the washer level, and hence performs a

1. Concrete bearing check on the embedment of the washer beyond the bolt void
2. Washer bending check either as
   a. single curvature if the embedment bearing width is less than 2 x that required, or else
   b. double curvature bending since there is more than 2 x minimum required embedment



Design to British Standard

Concrete Bearing Check of Washer

The **er** value required for the force Ft is calculated based on the bearing stress fcu*EmbedCoefficient.

$Ft = ((2*er+V)^2 – V^2)*fcu* EmbedCoefficient$

EmbedCoefficient – Set in basic data and defaults, usually 0.6.

Fcu – concrete cube strength

If e < er then a design warning is highlighted. If e > 2*er then double curvature washer bending is permitted, otherwise single curvature bending is used

Washer Bending Capacity

Single curvature

$Fw,rd = 1.2 * fy * t^2 * 4(V-d') / (6 * V/2)$

Double curvature

$Fw,rd = 1.2 * fy * t^2 * [4(V-d') + 4*V] / (6 * V/2)$

The capacity Fw,rd is checked against the applied bolt force Ft.

Design to EuroCode

Concrete Bearing Check of Washer

The **er** value required for the force Ft is calculated based on the bearing stress fcd of the concrete

$Ft = ((2*er+V)^2 – V^2)*fcd$

Washer Bending Capacity

Single curvature

$Fw,rd = fy * t^2 * 4(V-d') / (6 * V/2)/gamma\_m0$

Double curvature

$Fw,rd = fy * t^2 * [4(V-d') + 4*V] / (6 * V/2)/gamma\_m0$

Note:- In both the British Standard and Eurocode design, Double curvature is considered when the embedded length is twice what it needs to be, otherwise single curvature is considered. We don't have any documented justification for this – it is a rule of thumb.

Regards

MasterSeries Team ☺