
# Hilti welcomes you to the world of innovative products and quality services

# Agenda

Hilti Introduction

Post Installation of Rebar - Basics

Post Installation of Rebar - Design Concepts and Calculations

Post Installation of Rebar - Application

Open Session - Queries & Feedback

# At a glance


**•Hilti is one of the World's leading companies specialized in the field of fastening and demolition systems in the construction industry**

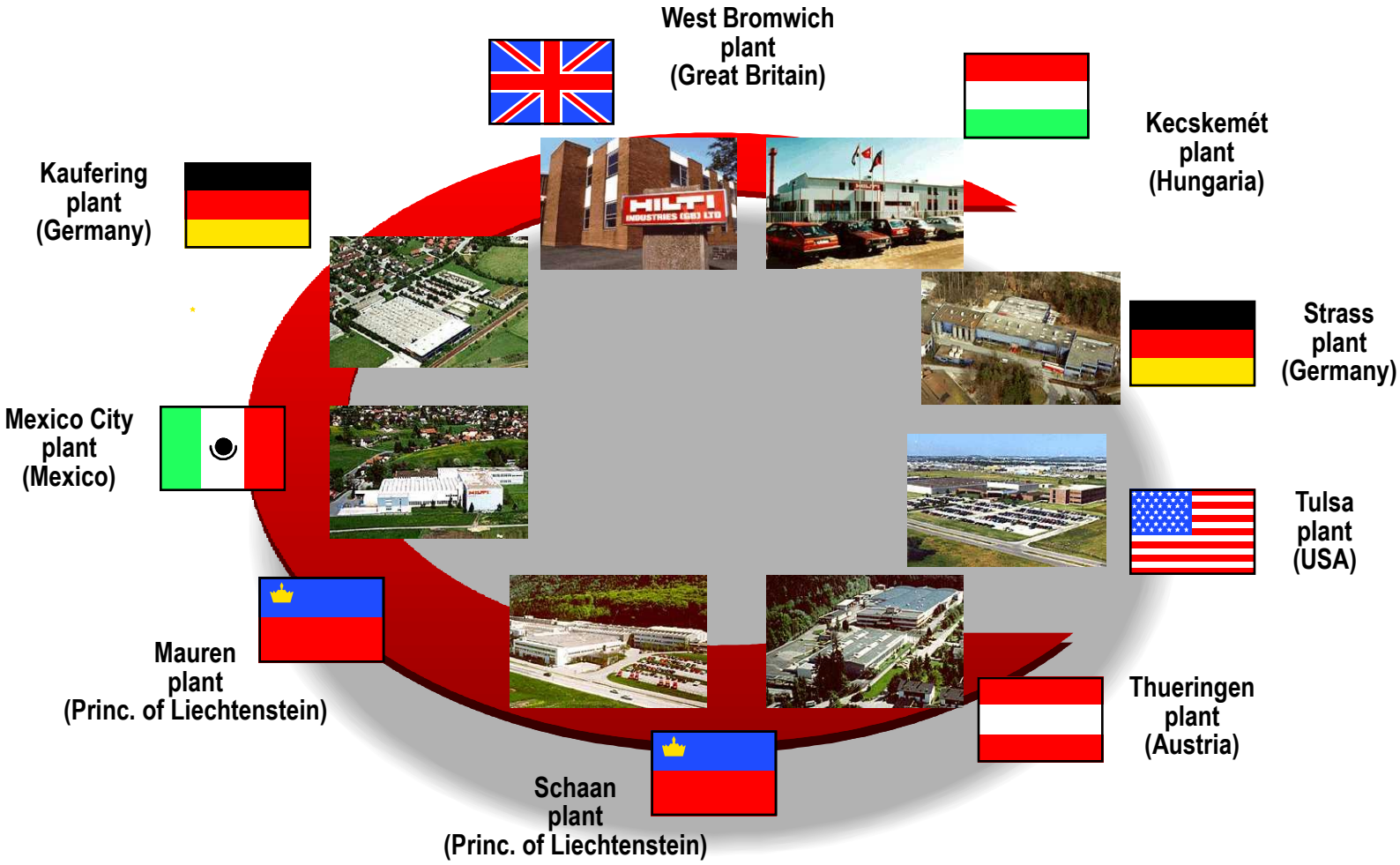
- **Quality**
- **Innovation**
- **Extensive application know-how resulting from close contact with customers**

# Principality of Liechtenstein

**Hilti Group**
More than
19000 employees
worldwide
About 1’600 in
Liechtenstein

- Liechtenstein
  **35’000 citizens**
  **162 square kilometres**

# Production Network




# PRESENCE OF HILTI IN INDIA - 2010

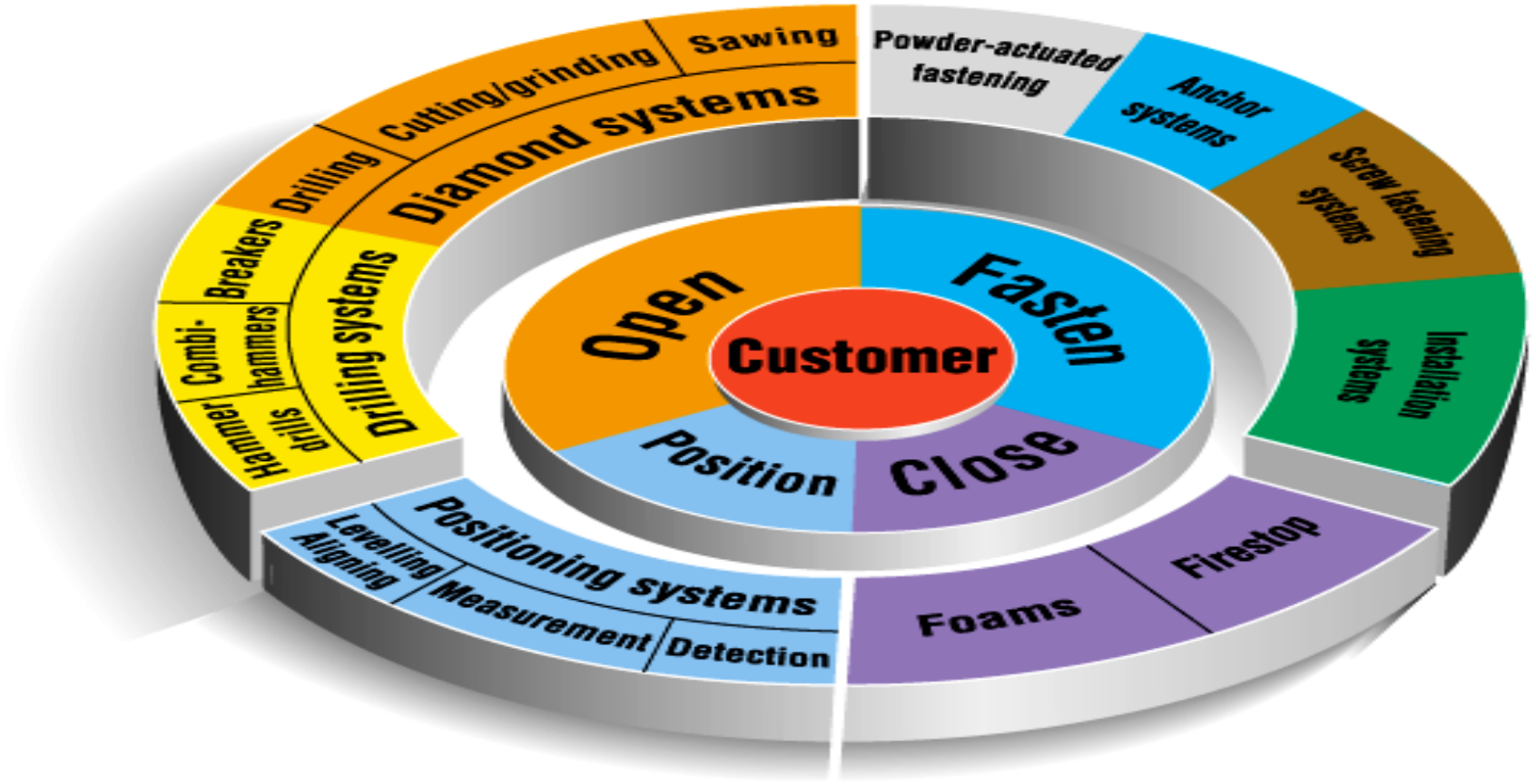
TS

HSC

FE/MSM

RM

# A complete coordinated offering from Hilti



# Post-Installed Rebarring Technology

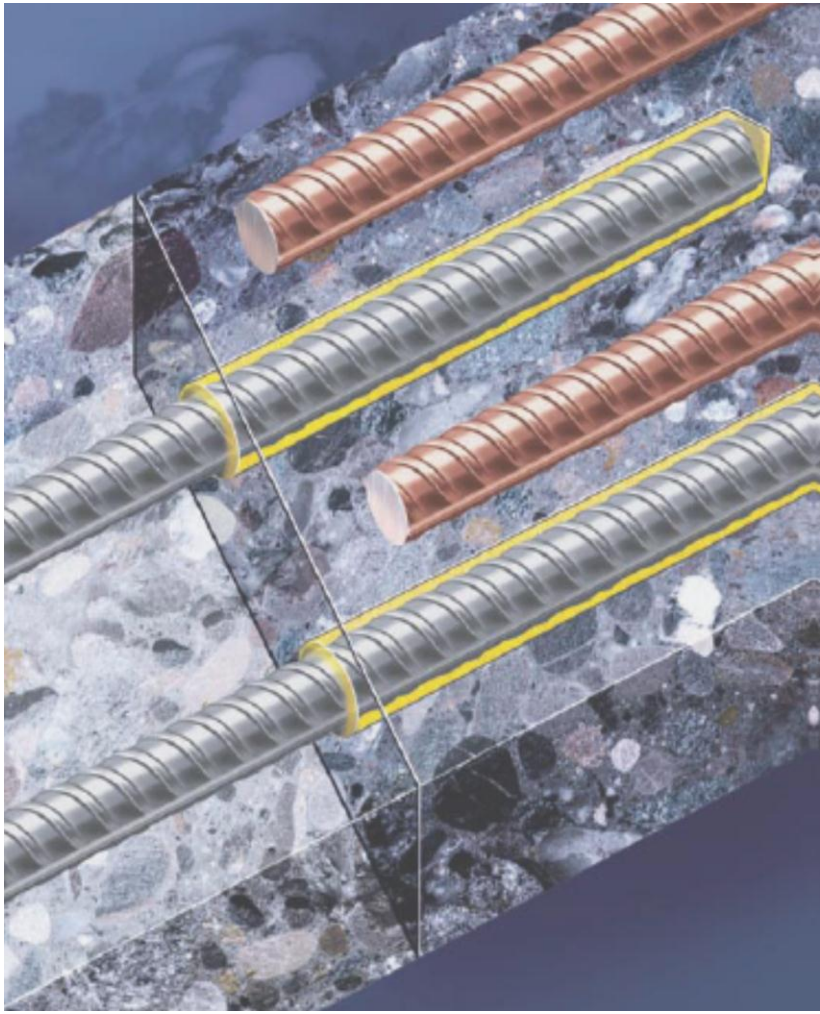
# Rebar Grouting

## What Is Rebarring

**Adding reinforcement to an existing concrete structure such that the structure behaves as a cast in structure**

## How Is Rebarring Done

- **Drill Hole in Concrete based on design**
- **Fill it with chemical**
- **Insert rebar and allow for chemical curing**



# Applications

## A) Simply Supported Connections

- Adding beam between columns
- Casting slab in a cutout

## B) Spliced Connections

- Extension of column
- Extension of beam/ slab
- Casting slab in a cutout

## C) Moment Connections

- Column from Raft/ Pile cap
- Cantilever beam from column
- Bracket on column

## D) Shear Connectors

- Thickening of slabs/ raft
- J bolting while jacketing

# Need for post-installation of rebars

## Misplaced or missing rebars

Post-installation is necessary when there is a rebar misplaced or completely missing due to error in construction

## Additional rebars

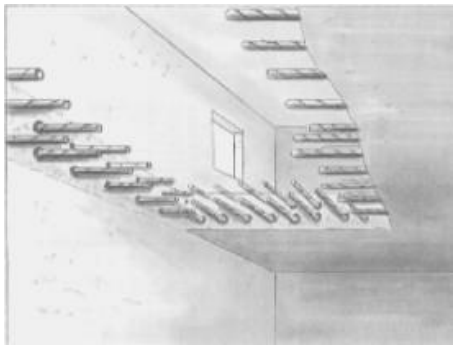
Corrections or additions to be made due to architectural changes or for additional strength

# Extention of slabs, balconies & stairs

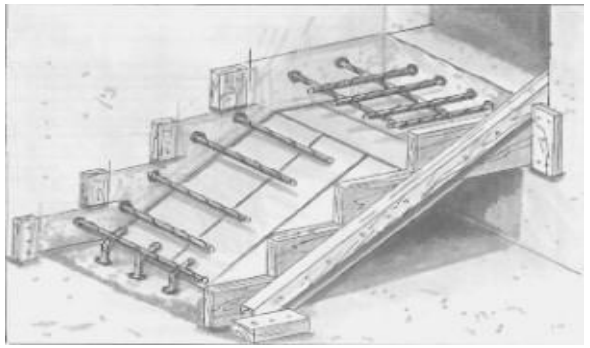
## Connections of new slabs


## Balcony extension

## Close openings / slab enlargement

## Connection of staircase



# Extention of columns, beams & walls

## Connection of new columns


## Extension of reservoirs

## Connection of beams


## Wall extensions

# Rebar Grouting

## Outcome

- No damage to existing concrete (Cost saving on prepare & repair)
- Precise controlled application (Quality of work & Speed)
- Flexibility in designs

## Role of Designer

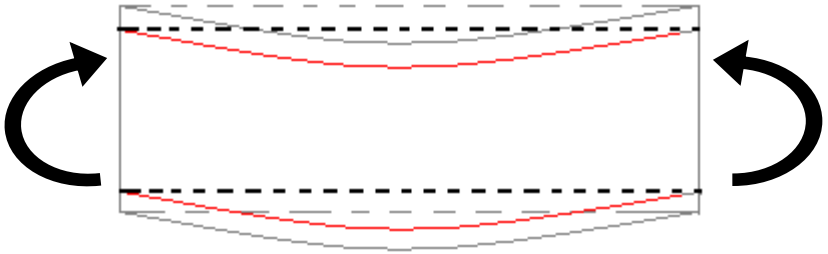
- To Provide Safe Design
  - Right Embedment depth
  - Right Steel details
  - Right chemical

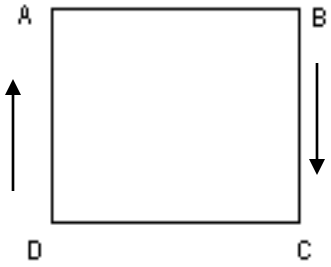
# What is Different Now ?

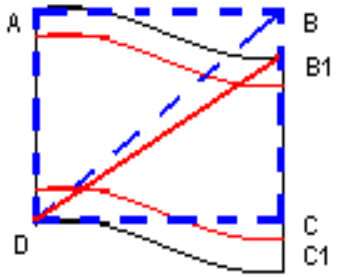
- Flow of forces in existing concrete?
- Modes of failure?
- Is it in alignment with the existing code?
- What is different from existing codes?

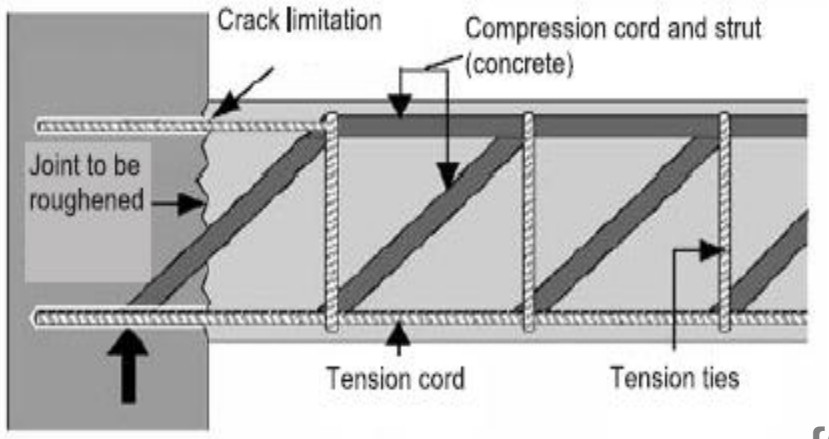
# Simply Supported Connections

**Challenge: For what force is embedment to be calculated ?**





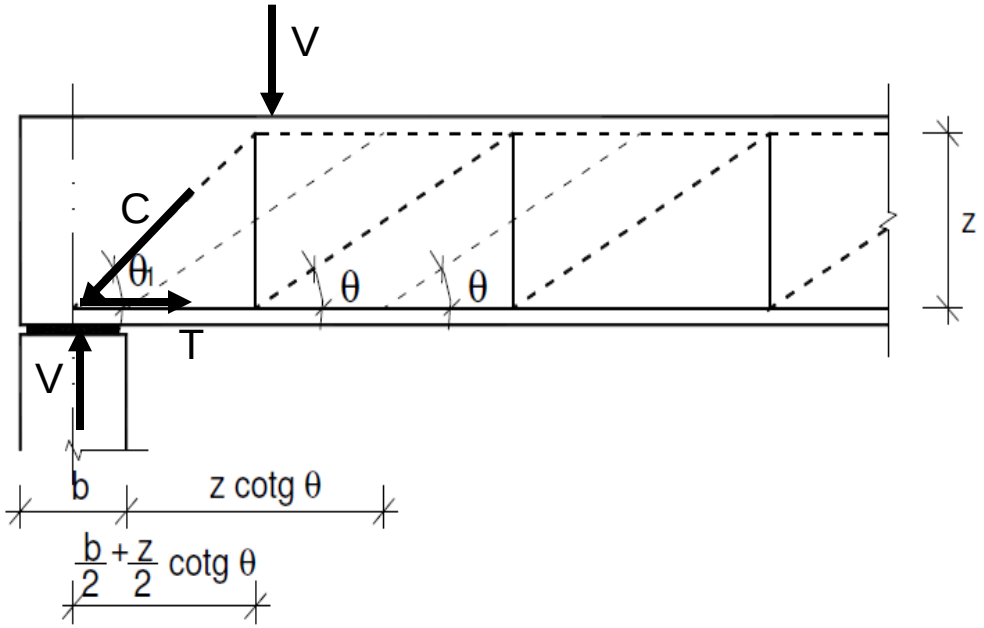



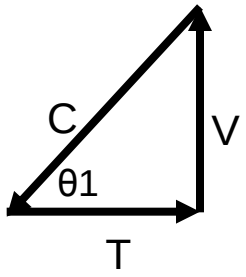




{Cl 6.5.1 (1), EC2:EN 1992-1-1:2004}

{Cl 5.6.4, EC2:EN 1992-1-1:2004}

# Simple Supported Joints




**T = (V cotθ)/2**
**T = total tension developed = V/2 X cot(θ)**
**V = applied shear load**
**θ = Angle between Tension Cord of steel & Compression Strut**
**(45° > θ > 21.8° as per Euro code 6.2.3)**

**T = 1.11 V**

# Calculation of Embedment Depth

**Load on Rebar <= Resistance Offered by Rebar**

**Failures to be Checked**

- **Bond**
- **Splitting**
- **Steel**

$$\ell_{b,rqd} = (\phi / 4) \cdot (\sigma_{sd} / f_{bd})$$

EC2 or IS 456

$$\ell_{bd} = \alpha_1 \cdot \alpha_2 \cdot \alpha_3 \cdot \alpha_4 \cdot \alpha_5 \cdot \ell_{b,rqd} \geq \ell_{b,\min}$$

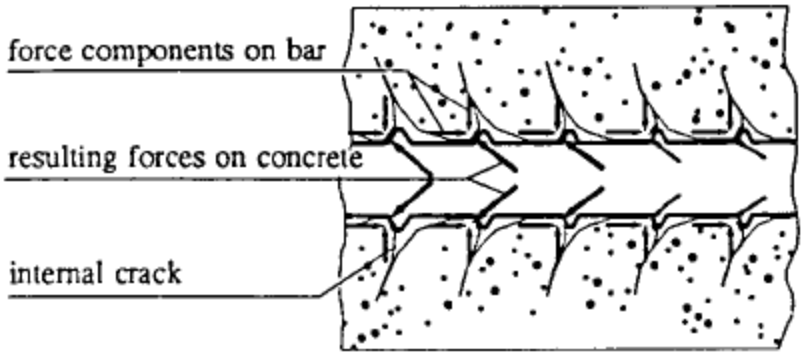
$$l_{bd,spl} = \frac{\phi}{4} \cdot \frac{\sigma_{sd}}{f_{bd}} \cdot \alpha_2 \longrightarrow \alpha_2 = 1 - 0.15 \cdot \frac{c_d - \phi}{\phi}$$

When C/d <=3

$$\longrightarrow \alpha_2' = \frac{1}{\frac{1}{0.7} + \delta \cdot \frac{c_d - 3 \cdot \phi}{\phi}}$$

When C/d >3

# Splitting



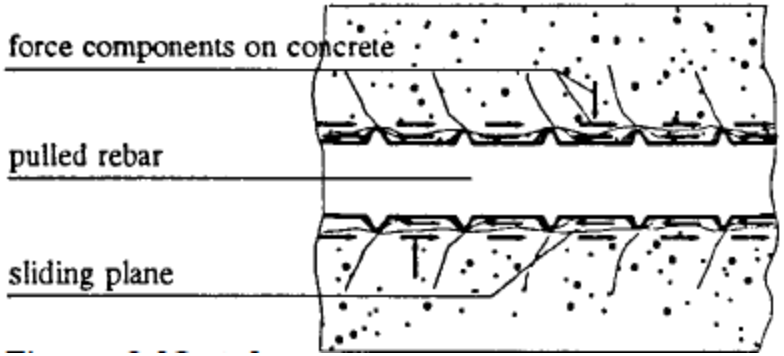




Figure 2b: Splitting

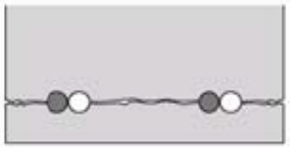
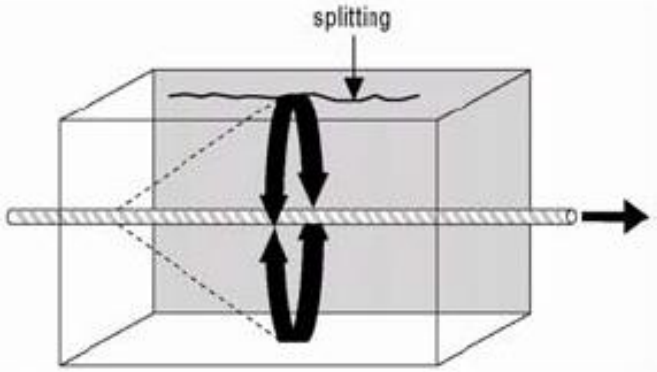
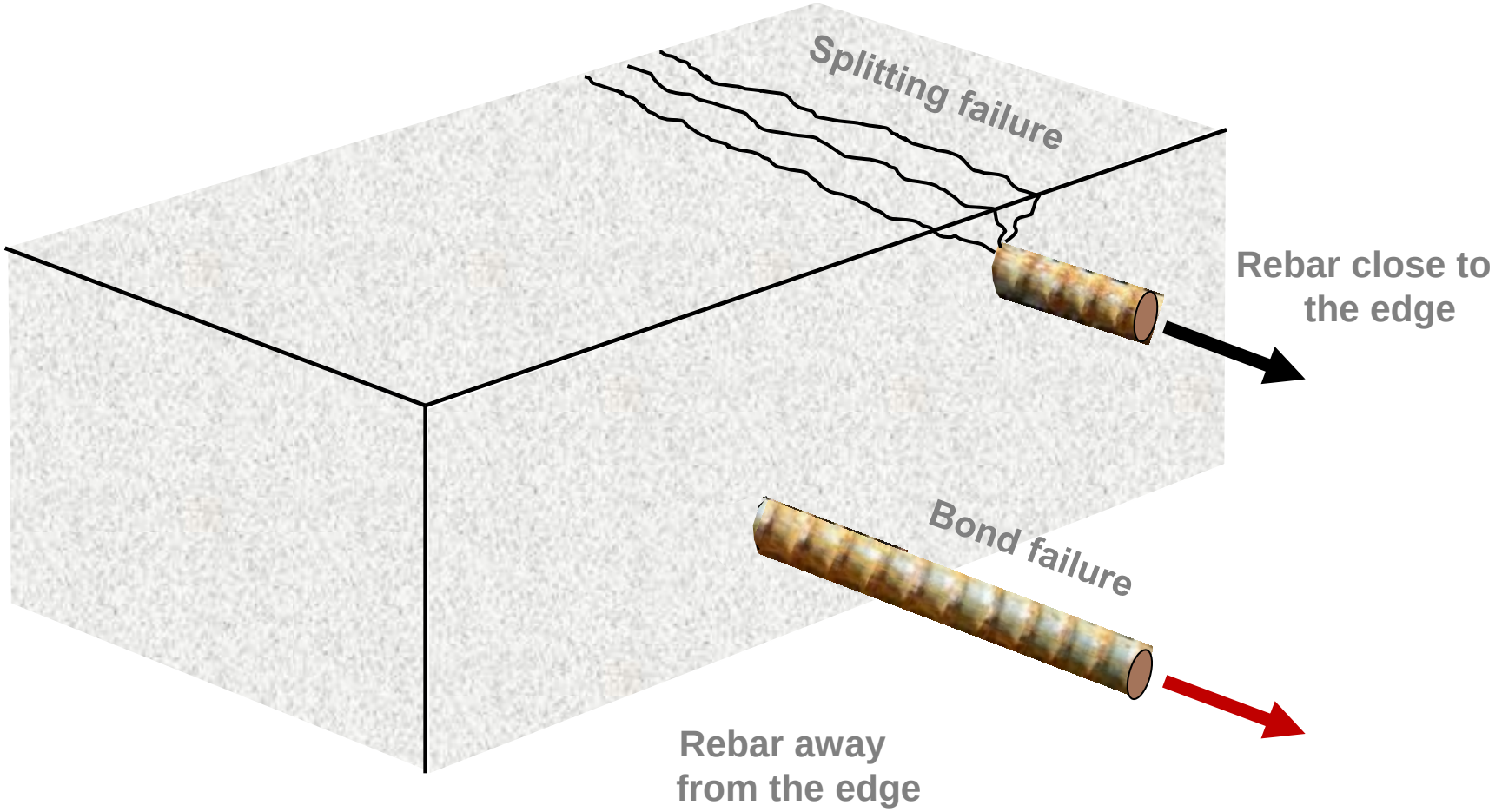


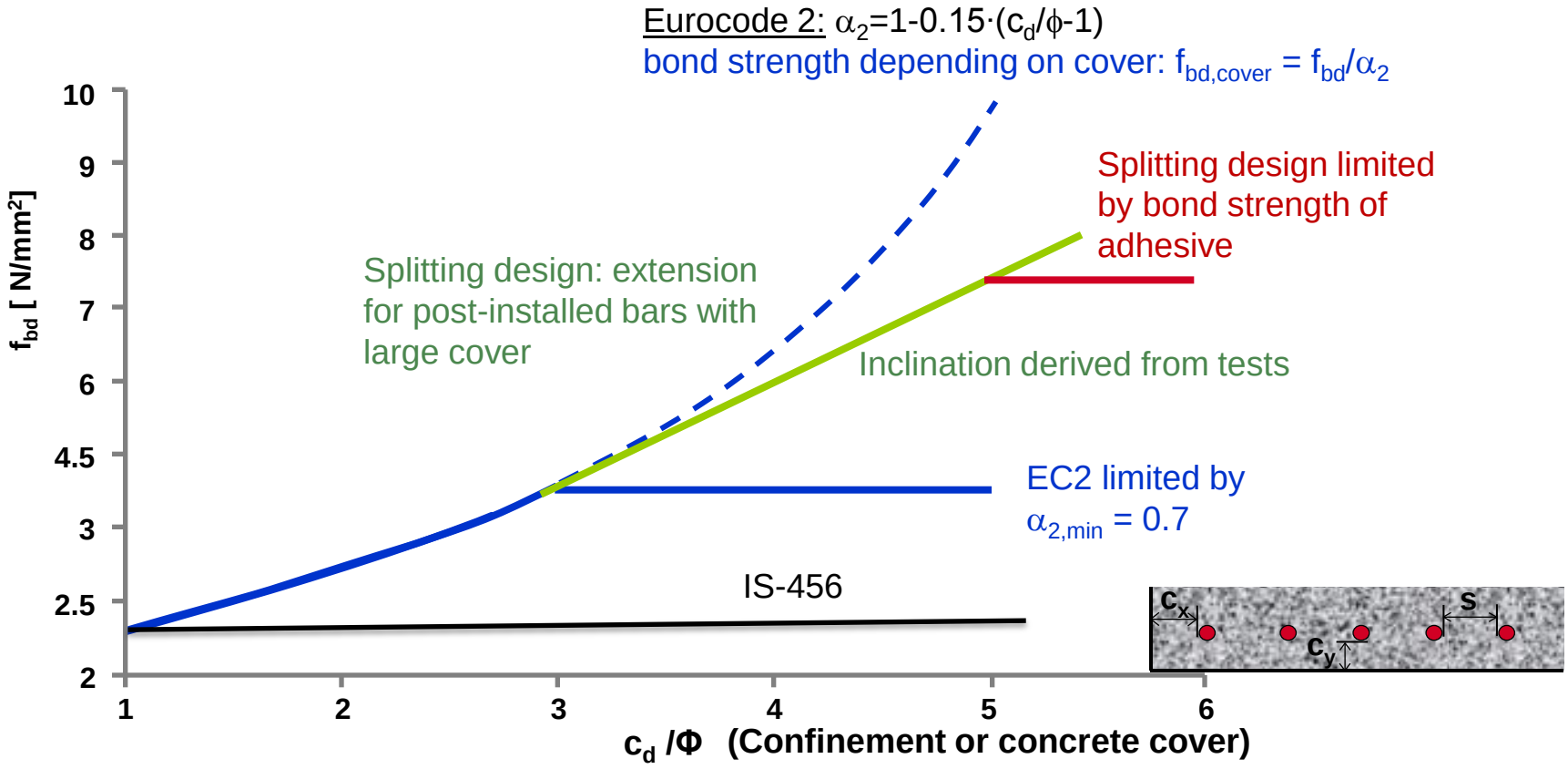
Figure 2c: Spalling



# Failure mode of rebars depends on concrete cover



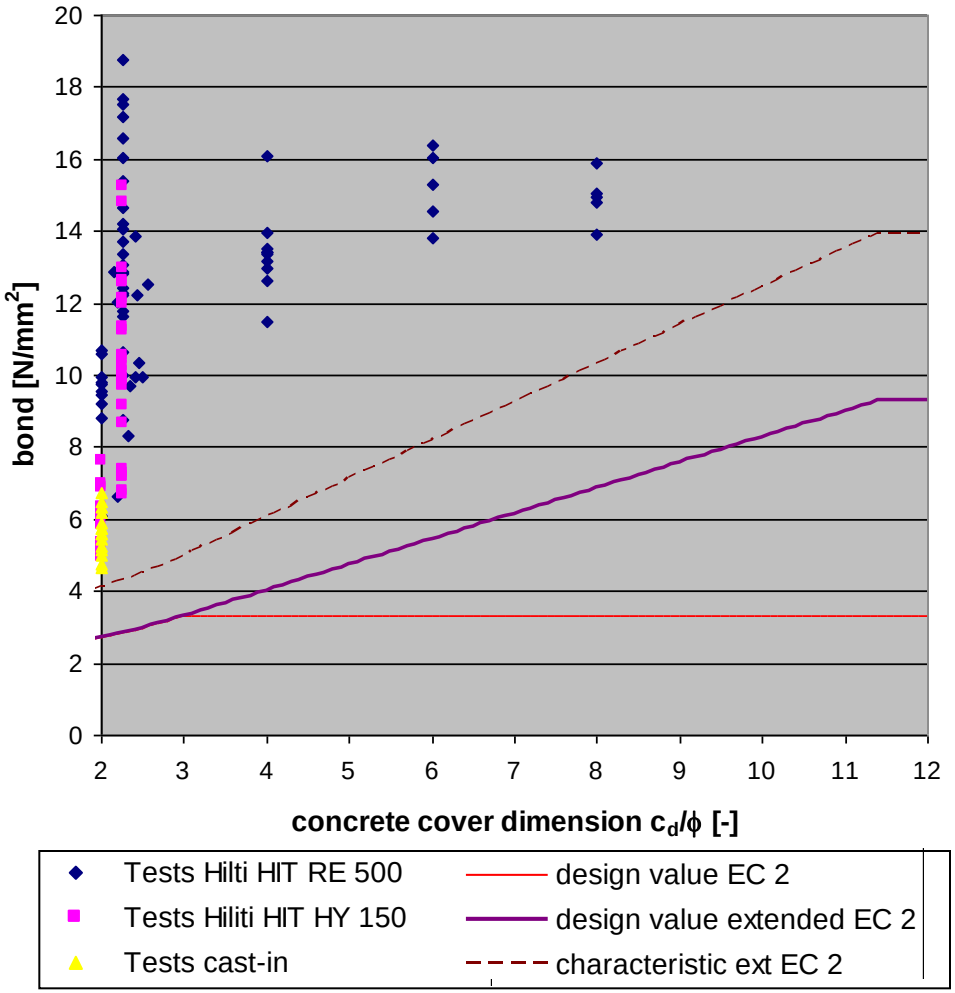
# HIT-Rebar design method (Splitting design) considers the real adhesive bond strength



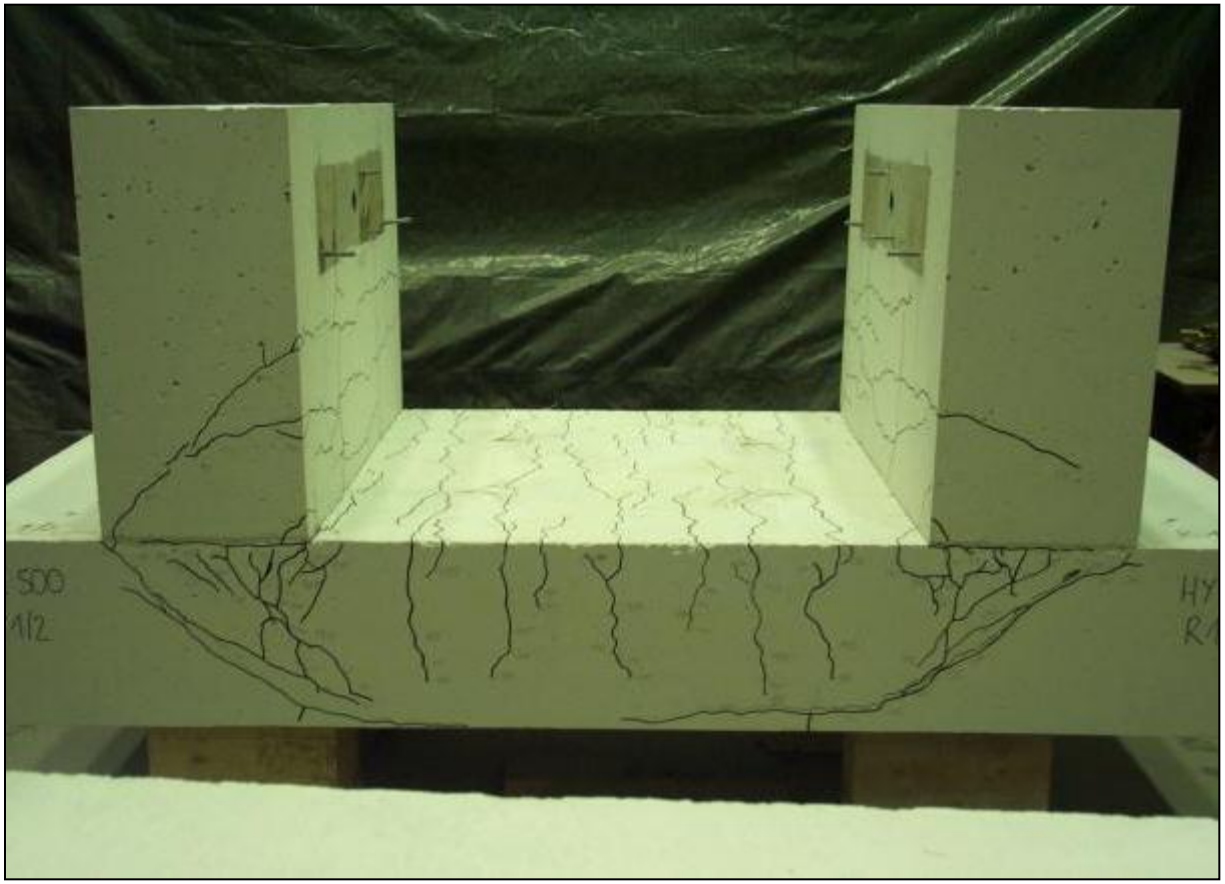

**This makes ductile design possible for moment resisting connections with straight bars**

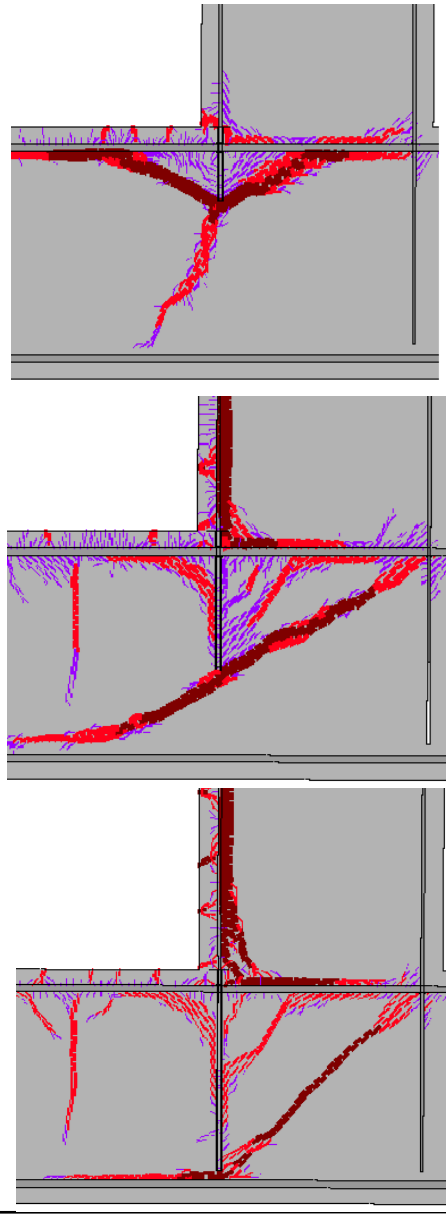
# Validation on basis of consolidated tests

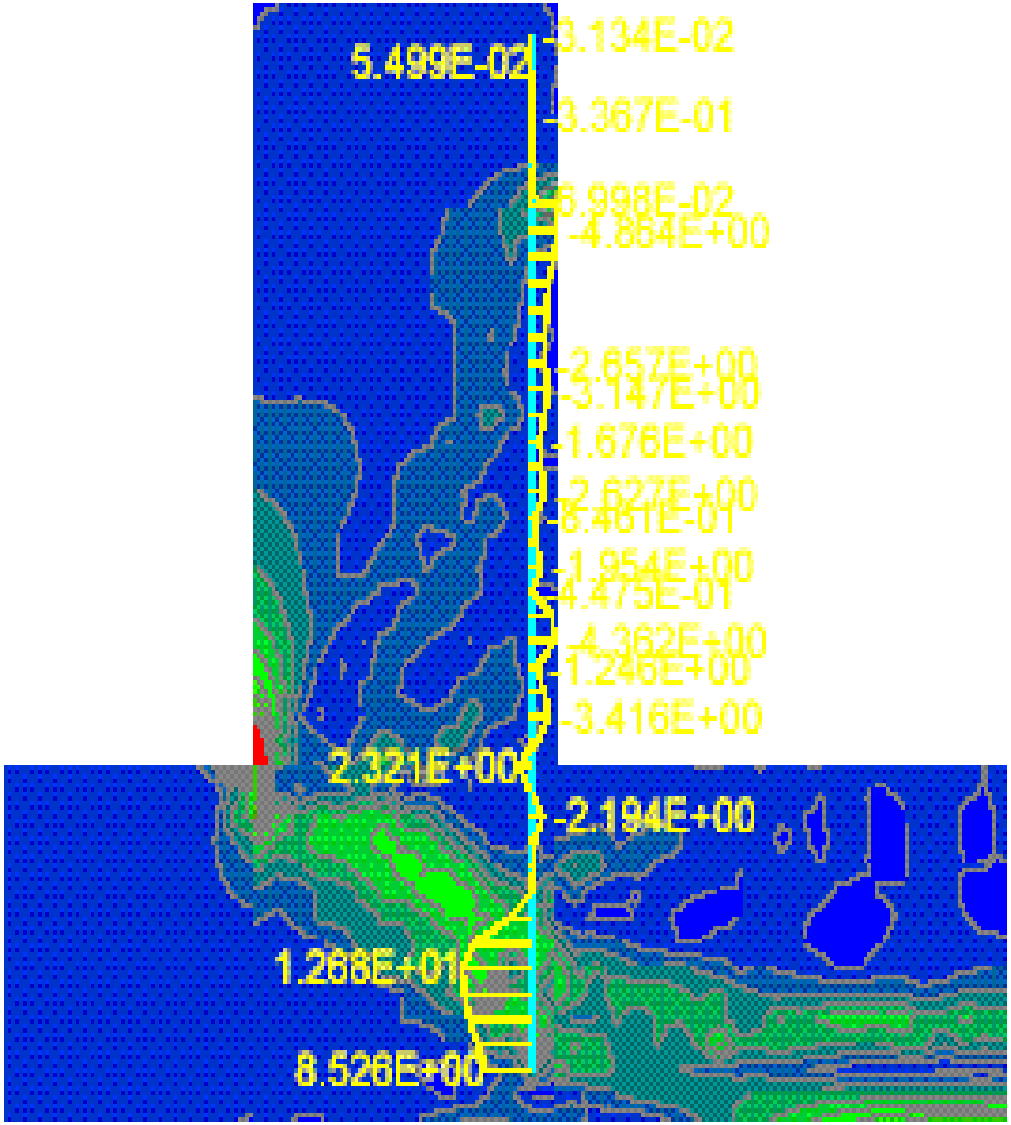
**Several pull-out tests have been conducted to check consistency in performance**




# Moment Connections






5.499E-02
-3.134E-02
-3.367E-01
-6.998E-02
-4.854E+00
-2.657E+00
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-1.676E+00
-8.461E-01
-1.954E+00
-4.475E-01
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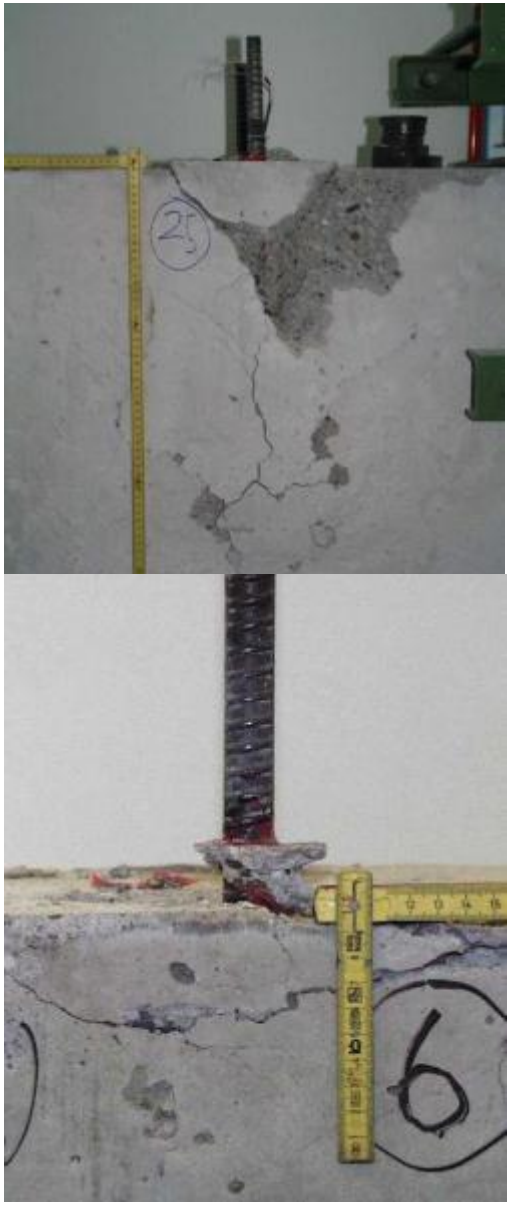
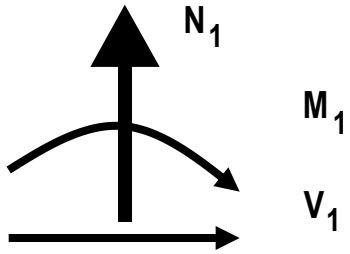
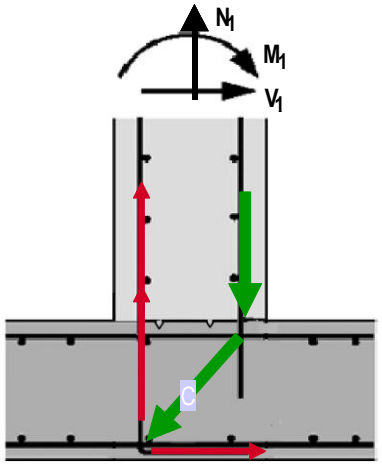
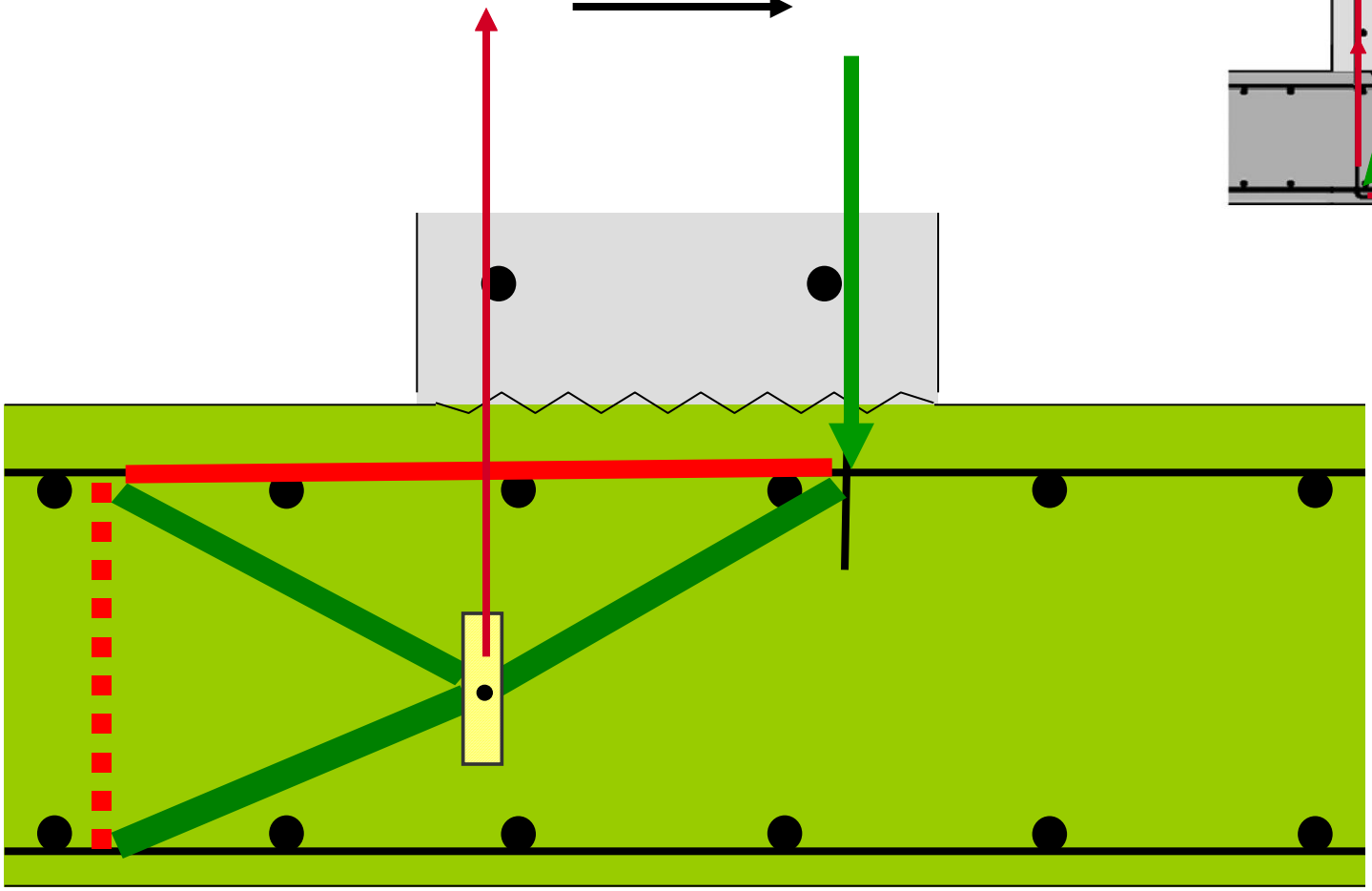
-2.194E+00
1.268E+01
8.526E+00



# Frame Node



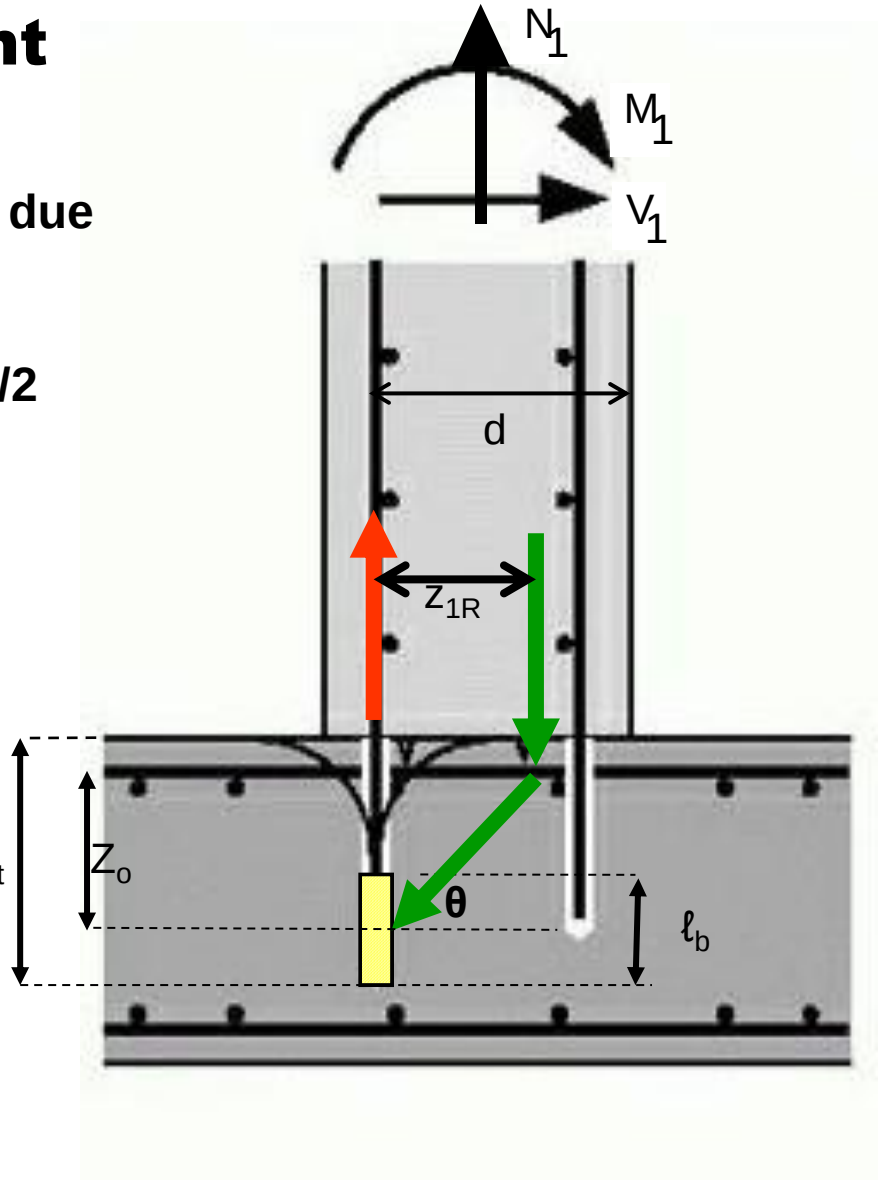
# Finding Safe Embedment

- Find Basic Anchorage Length ($l_b$) due to Splitting/ Bond for Force T1
- Calculate $L_{inst} = c_u + Z_{1r} \tan(\theta) + l_b/2$

$T_1 = M_1/z_{1R} + N1/2 + V/2 \cot(\theta)$

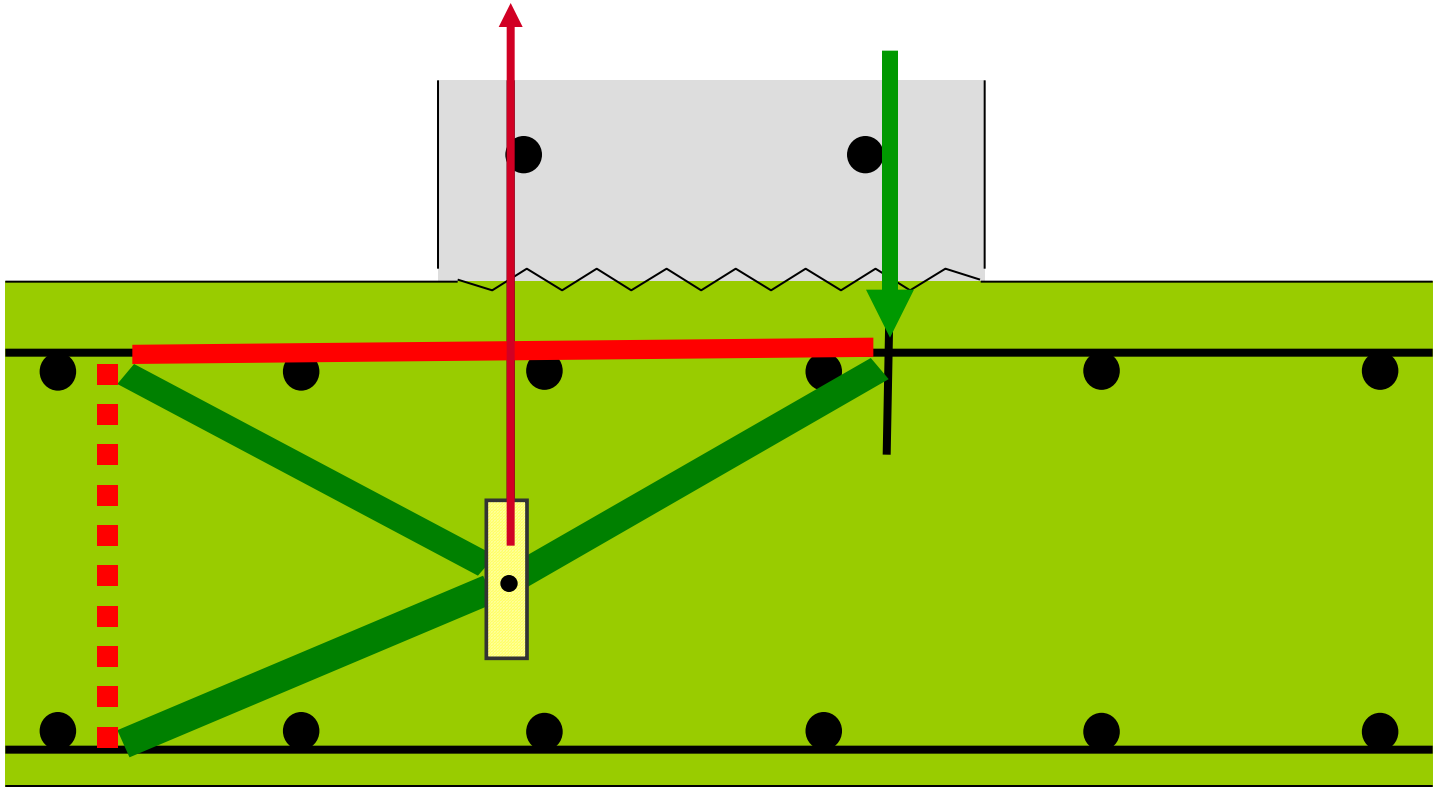
$Z_{1R} = 0.9*d$

$30^o < \theta < 60^o$



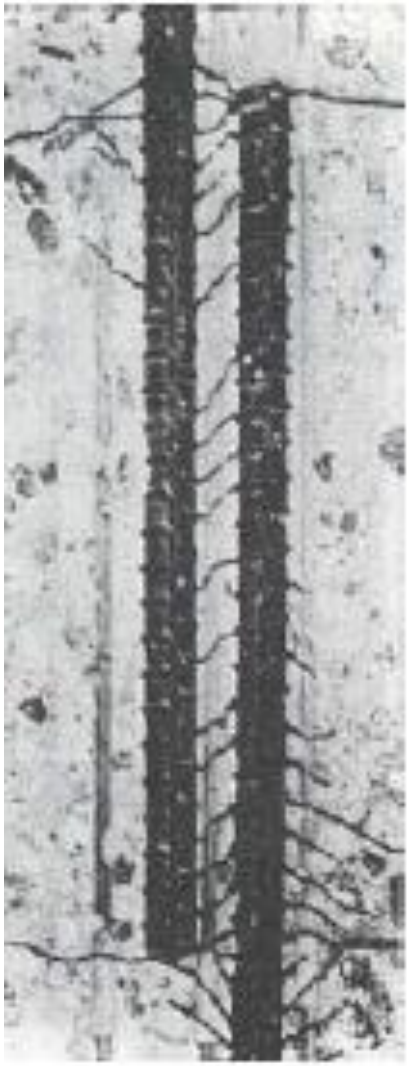
# Additional Checks

1. Concrete Capacity against Compressive Strut
2. Capacity of perpendicular rebars against additional forces
3. Tensile Capacity of Concrete Against Splitting Forces



# Splice Connections

- Load Transfer Mechanism: 45º Compressive Struts
- Ideal Clear Spacing between bars < 4XΦ



## Calculation Steps

1. Calculate Load T1 $T_1 = M_1/Z + N_1/2 + V/2 \cot(\theta)$
2. Find Embedment Required for Post-Installed Rebar
   - Use Hilti Method to Check for Bond/ Splitting
3. Find Embedment Required for Cast-In Rebar
   - Use Regular Country Codes (EC2, IS 456)
4. Required Splice Length = Max (Post Installed; Cast-In)
5. Multiply with Additional Factor $\alpha_6 = 1.5$

## Summary

1. **HIT-Rebar design method overcomes code limitations and hence provides post-installed solutions otherwise not feasible**

2. **Use HIT-Rebar design method to utilize the full bond strength of the Hilti adhesive by going beyond Eurocode 2**

# Beyond Design…

## Chemical Selection may depend on parameters like:

- Temperature range (long/ short)
- Drilling method
- Effect of chemicals
- Creep Behaviour etc…

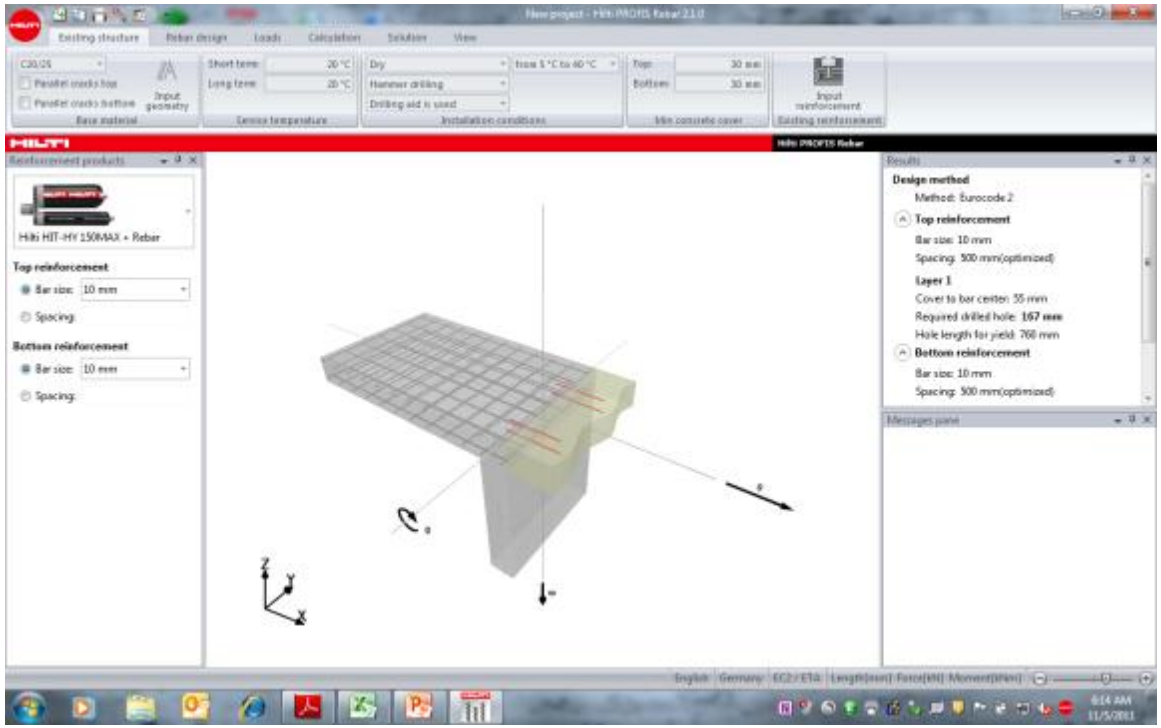
## Special Care in Application with Deep Embedment

- Proper Cleaning
- Usage of Piston Plug

- Application Video..\..\Rebarring\Rebar campaign\Profi kit video\HILTI-REBAR-MOVIE-V2.0EN.mpg

# Hilti Support to Designers

- Provide Calculation Reports as per EC2/ EOTA TR 023/ Hilti Rebar Method
- Provide tools for calculation – Software Profis Rebar, Manuals etc.
- Provide Technical Approvals/ Certificates
- Testing at Site
- Training on Software



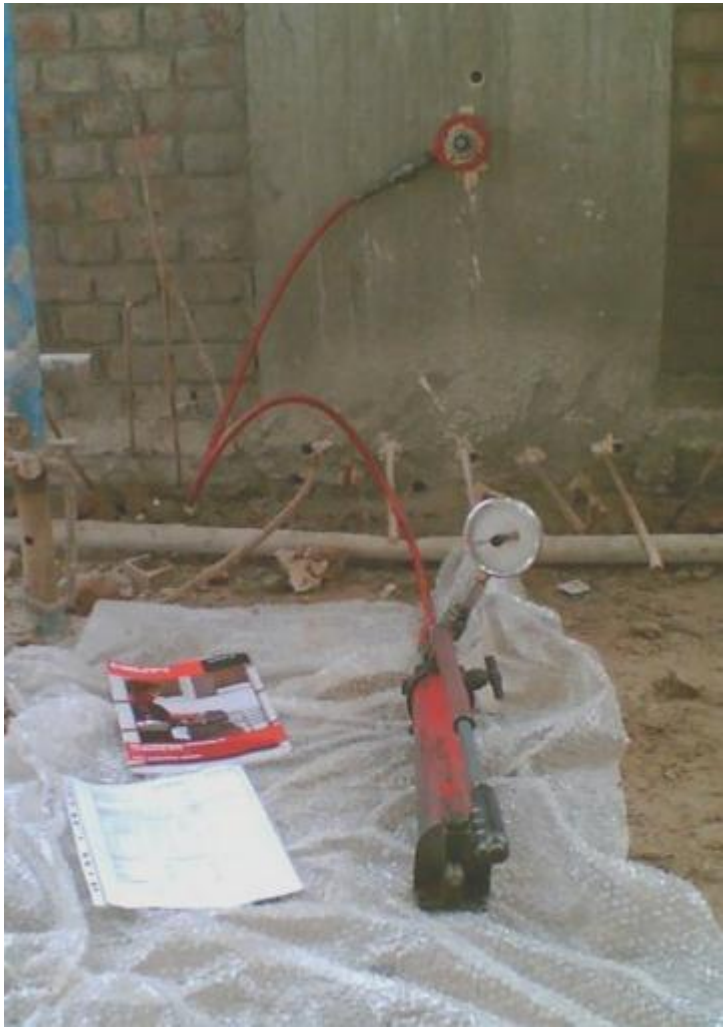
# Hilti Services

## Design (Free of Charge)

- Selection of Chemicals
- Design based on international codes
- Specifications
- Rebar Pull-out Testing at site

## Application

- Training at site( Free of Charge)
- Trained applicator Network
- Repair facilities for all tools used in rebar grouting applications




# Thank You

## Ashish Mittal (9811150266)