

The Institution of
StructuralEngineers

Design and assessment of reinforced concrete Transfer Slabs

Institution of Structural Engineers
July 2026



Introduction

**What's a transfer slab?
Where are they found?
What are the issues?**

About Transfer slabs

Where to find transfer slabs:

What & why a transfer slab?

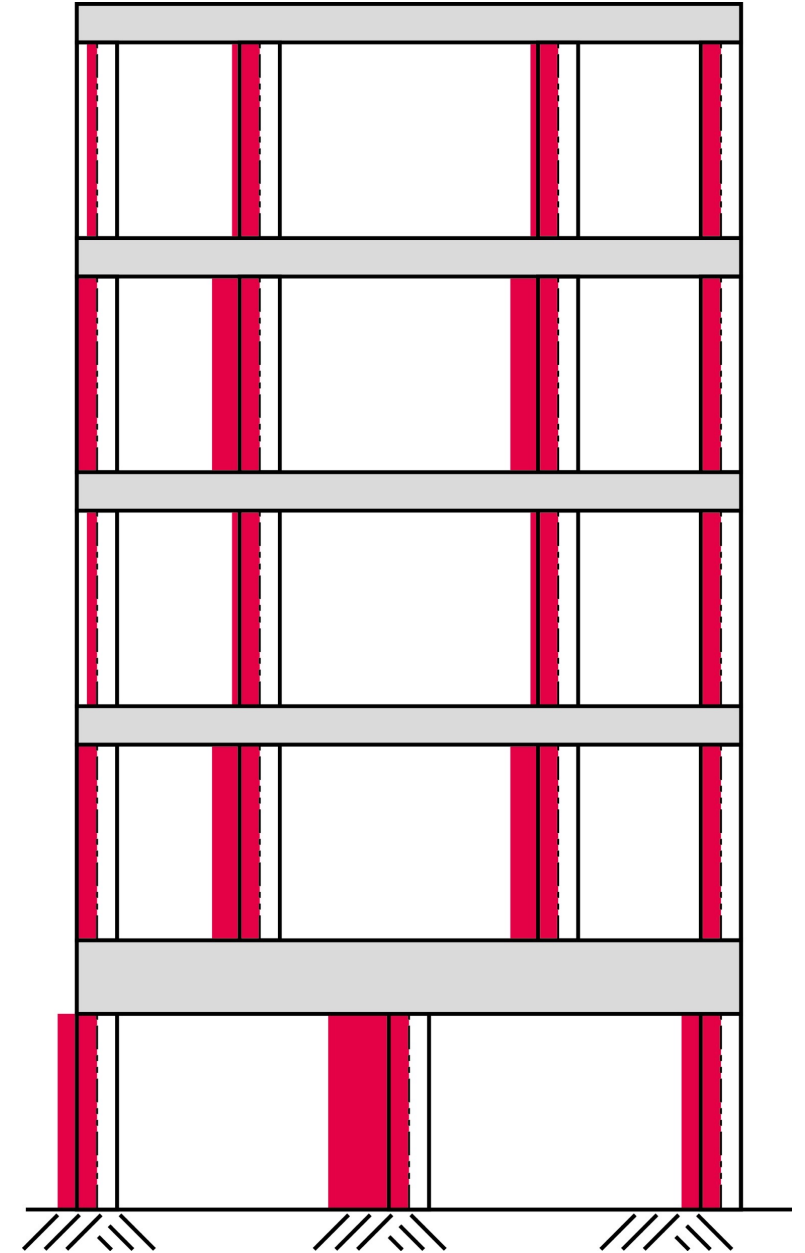
- A flat (thick) plate between two separate column grids
- Allows building grids to be mixed/ changed
- Provides a flat soffit: simple formwork

Which Buildings ?

- Mixed use residential developments 5-20 storeys
- Hotels
- Since 2,000's:
 - D&B procurement
 - Flat formwork cheaper & quicker than downstand beams
 - FE software allowed complex configurations to be designed

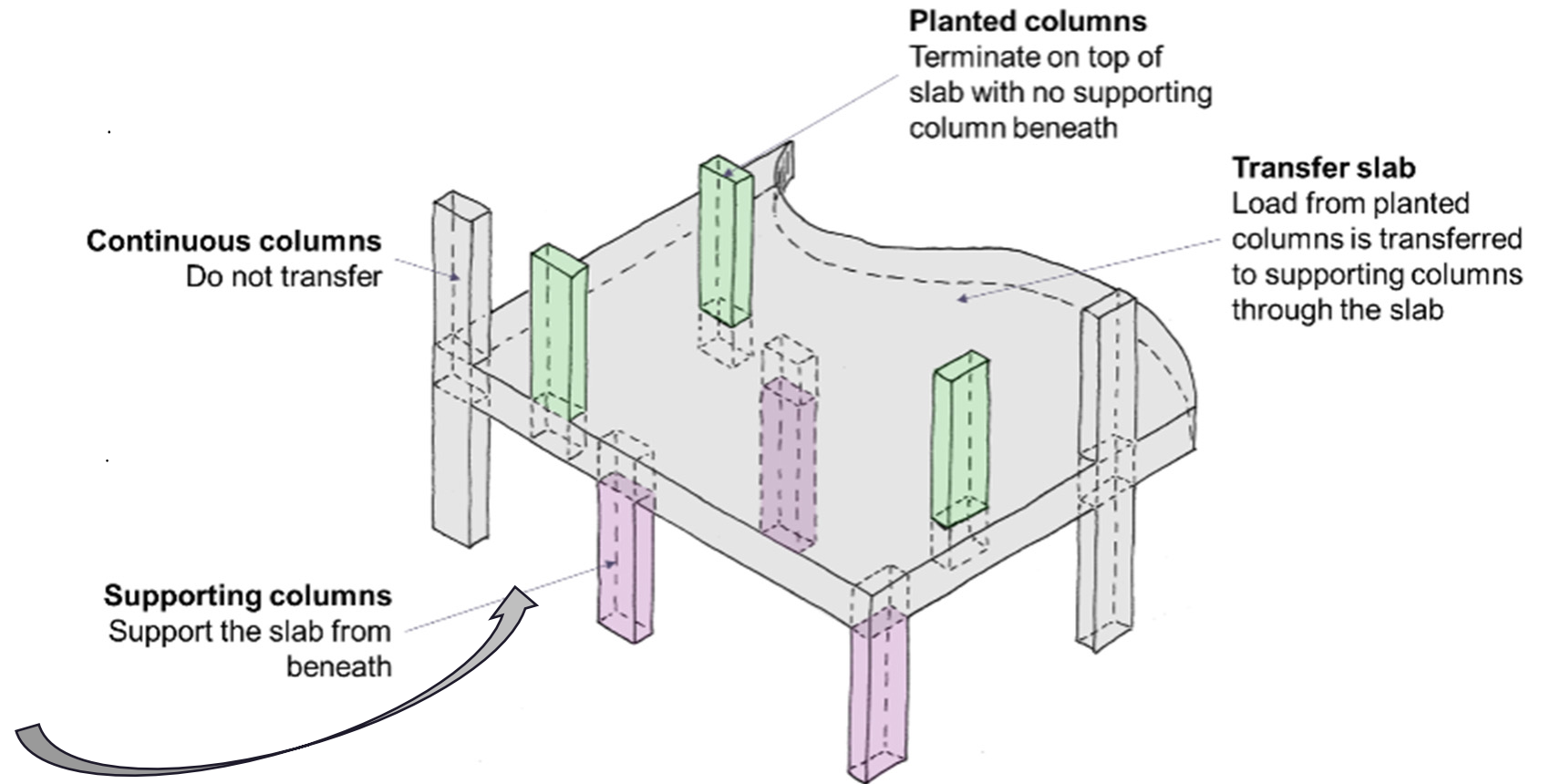
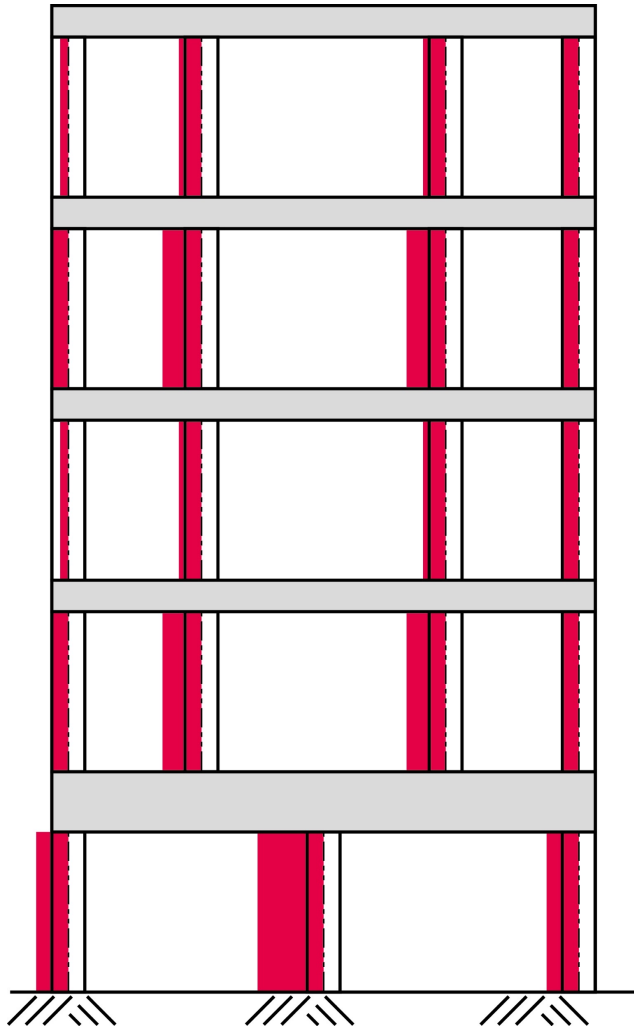
Common transfer slab locations

- **Ground floor podium slabs:** separating underground car park from building above
- **Podium in mixed use tower block:** separating Ground Floor retail space (with wider column grid) from residential apartments above (with smaller grid)
- **At Penthouse Level:** to allow edge columns to step back from the façade line, creating roof garden space



About Transfer Slabs

What is a transfer slab?



About Transfer Slabs

What are the Issues?

Concerns with the form of construction have been highlighted in the IStructE HRB compendium and CROSS report 1301.

- **Punching Shear.**
 - Existing code methods do not adequately cover design of areas between closely spaced transfers
 - Failure is brittle and sudden
 - Transfer structures are key elements, limiting redistribution
 - Failure is likely to be significant
- **3D-structural frame Analysis**
 - Where the structure is analysed in 3D, this may result in an underestimate in transfer slabs loads

Punching shear assessments of flat slabs supporting out of line columns

CROSS Safety Report Report ID: 1301

This report relates to punching shear assessments of flat slabs used as transfer slabs to support transferred columns (i.e. columns above the transfer slab which are misaligned with the columns below). The reporter is concerned some design engineers erroneously use the principles of uniformly loaded slabs to assess punching shear in such cases.

Key Learning Outcomes

For designers:

- Be aware of the background to codes and of the principles behind computer modelling systems
- When using codified rules outside of situations for which they were written, the validity of these rules needs to be questioned and checked using alternative methods

- The use of standard calculations for symmetrical column arrangements (such as spreadsheets) should be questioned when the layouts are asymmetrical
- Read and take note of The Institution of Structural Engineers published guidance on this issue, [Design of Transfer Slabs](#) in November 2024

Full Report

Through peer review work, the reporter says their firm has observed transfer slabs analysed using a Finite Element Analysis model (which provides reactions on the supporting columns) to obtain moment plots for determining the bending reinforcement. These reactions are put into spreadsheets, the reporter continues, that are only intended to quantify the shear reinforcement for a flat slab with a uniform load, amplified with beta factors. This underestimates the localised shear stress between non-aligned columns as it ignores the shear concentration between them.

The reporter explains that, for cases where a transfer slab supports a transferred column and there is close proximity between the transferred column and the supporting column, there is a highly stressed zone of concrete between the two columns (see Figures 1, 2, and 3).

Whether a local inclined strut calculation or a punching shear assessment of the transfer slab is required, the reporter continues, depends on the proximity of the columns. However, even for transferred columns spaced apart in the range normally applicable to punching shear, they add that the punching shear stresses can be significantly higher than the stresses obtained from a conventional assessment (intended for flat slabs with uniform loading and without transferred elements).

The reporter explains that, to allow for uneven distributions of shear stress around the support, design shear stress in a conventional punching shear assessment for a uniformly

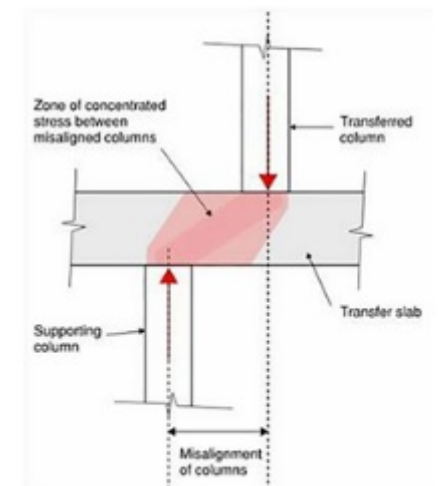


Figure 1: Illustration of offset columns

About Transfer Slabs

Other Design Considerations Specific to Transfer Slabs

- **Design bending moments in supporting columns**
 - Moments induced in the supporting columns by first order frame effects may be large (particularly at edge and corner columns)
- **Interface between deep slab and supporting walls**
 - Modelling the wall-to-slab interface as a hinged connection is unlikely to capture the interface in sufficient detail to enable walls to be designed correctly
- **Robustness**
 - Transfer slabs and their supporting structures are key elements
- **Movement, shrinkage and long-term deflection**
 - Effect of stiffness and long-term movement on load paths
 - Thermal gradients and shrinkage forces
- **Sustainability**
 - Transfer slabs are heavy and structurally inefficient, and drive up the embodied carbon of the development
- **H&S Implications**
 - Specialist design of reinforcing chairs for deep slabs
 - Large volume continuous pours
 - Use of large diameter bars to achieve required reinforcement percentages
 - Complexity of propping and construction (propping to support the wet load of transfer slab, back-propping of slabs above the transfer slab, etc.)

About Transfer Slabs

IStructE Guidance

As a result of these issues IStructE produced guidance to

- Highlight the issues
- Fill the knowledge gap

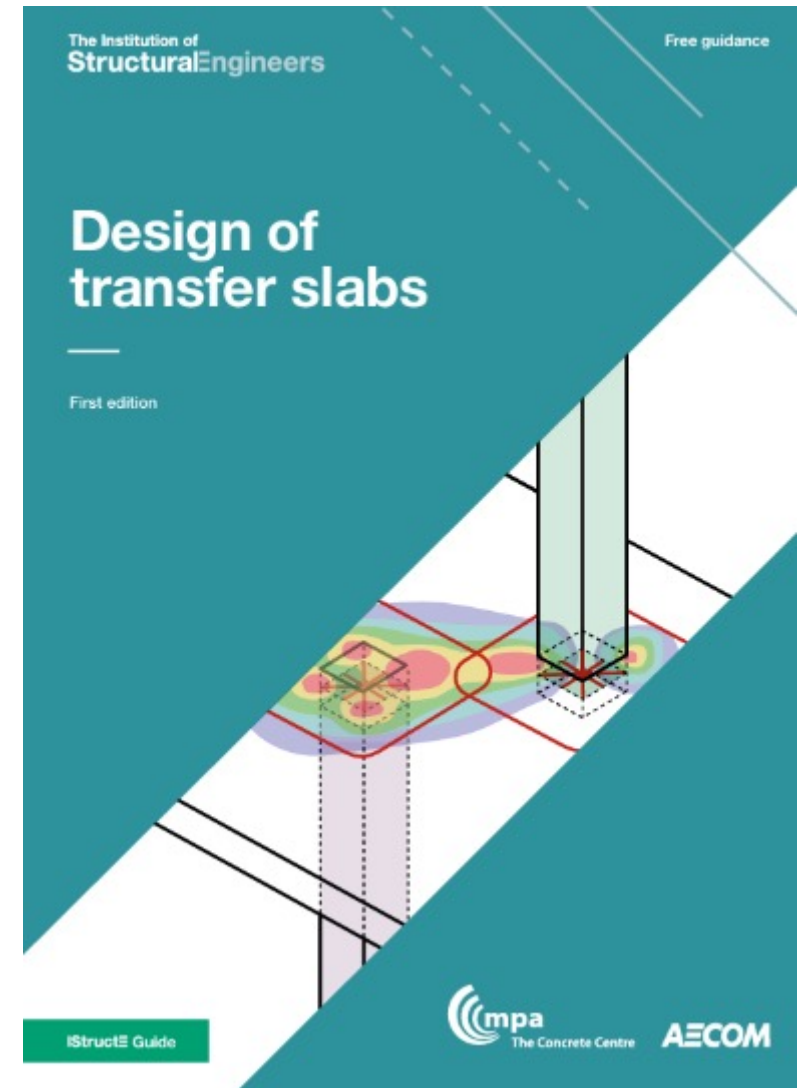
Whilst guidance is for new-build, it may be used to assess existing structures

Guidance is suitable for:

- Designers
- Checkers/ Assessors
- Contractors

Guidance is free and been downloaded over 5,000 times

<https://www.istructe.org/resources/guidance/design-of-transfer-slabs/>



What to look out for

Sizing
Modelling
Designing
Detailing

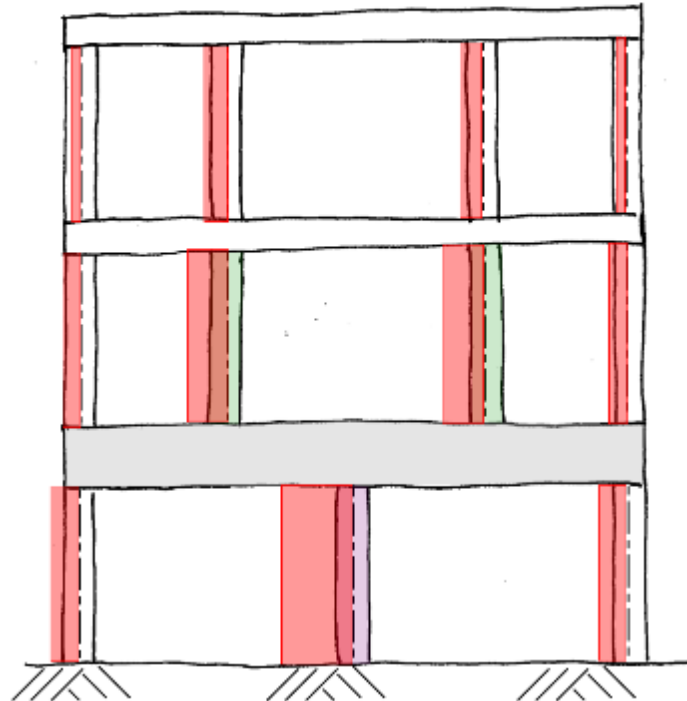
What to look out for: Sizing

Is the transfer slab thick enough? - Stiffness

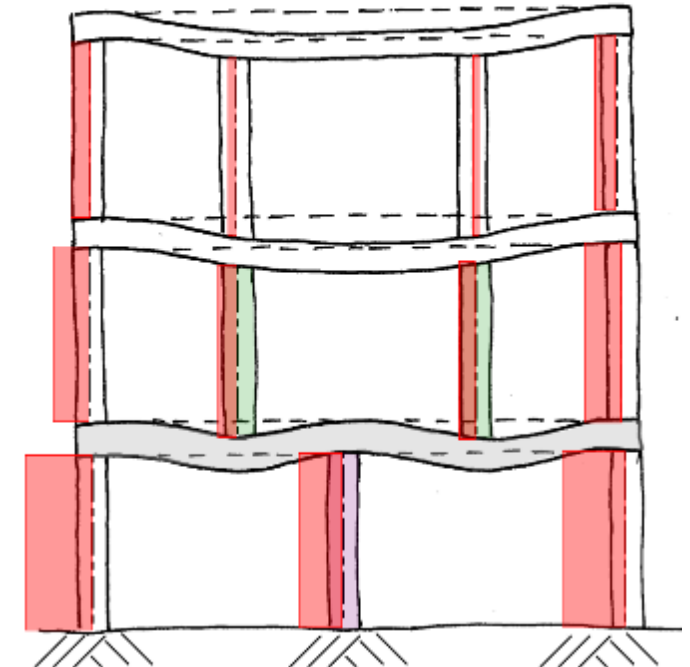
- Span to depth ratios are normally used to size elements; these are generally not appropriate.
- Designers must consider at concept stage: stiffness to:
 - Control deflections
 - Minimise secondary forces in the structure above
 - Prevent load redistribution due to column settlement

Deflection leads to cracking of partitions & finishes

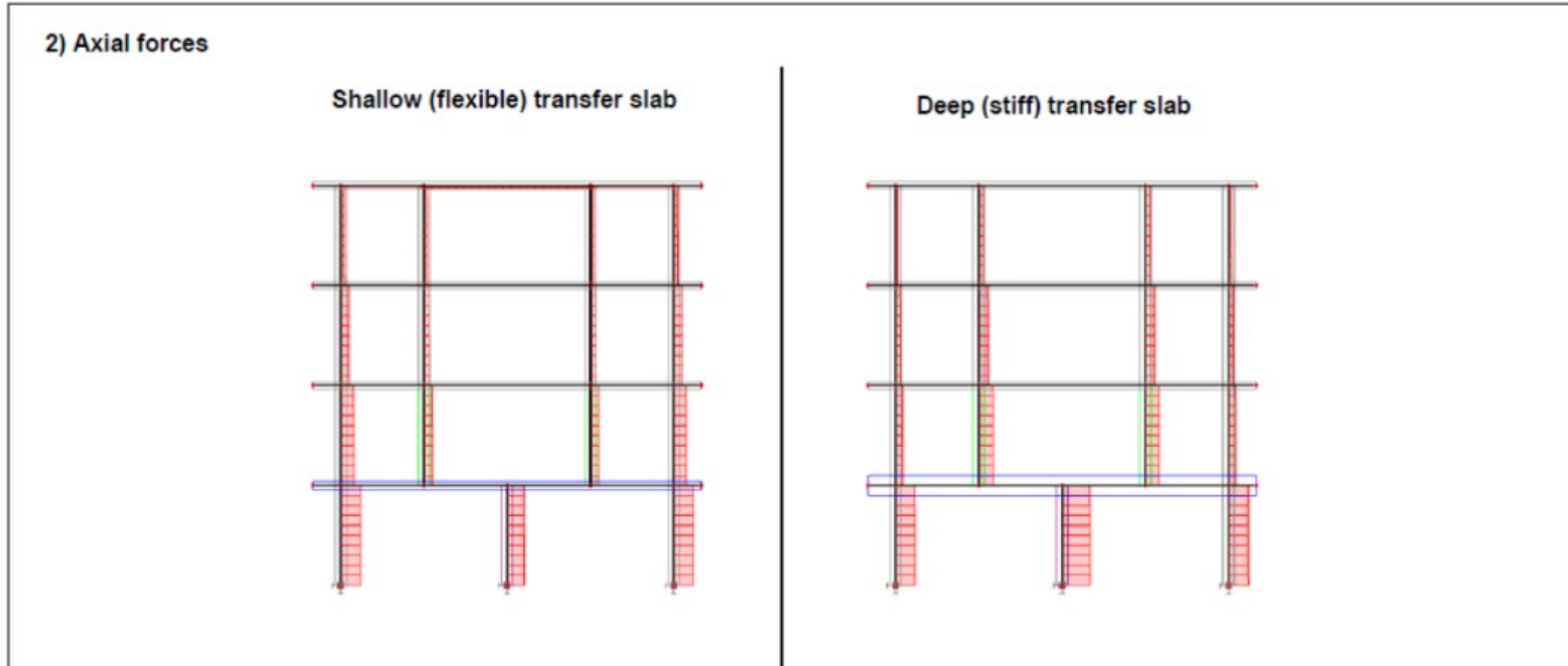
Deep (stiff) transfer slab
Building load path similar to tributary area distribution



Shallow (flexible) transfer slab
Planted columns shed load into adjacent continuous columns

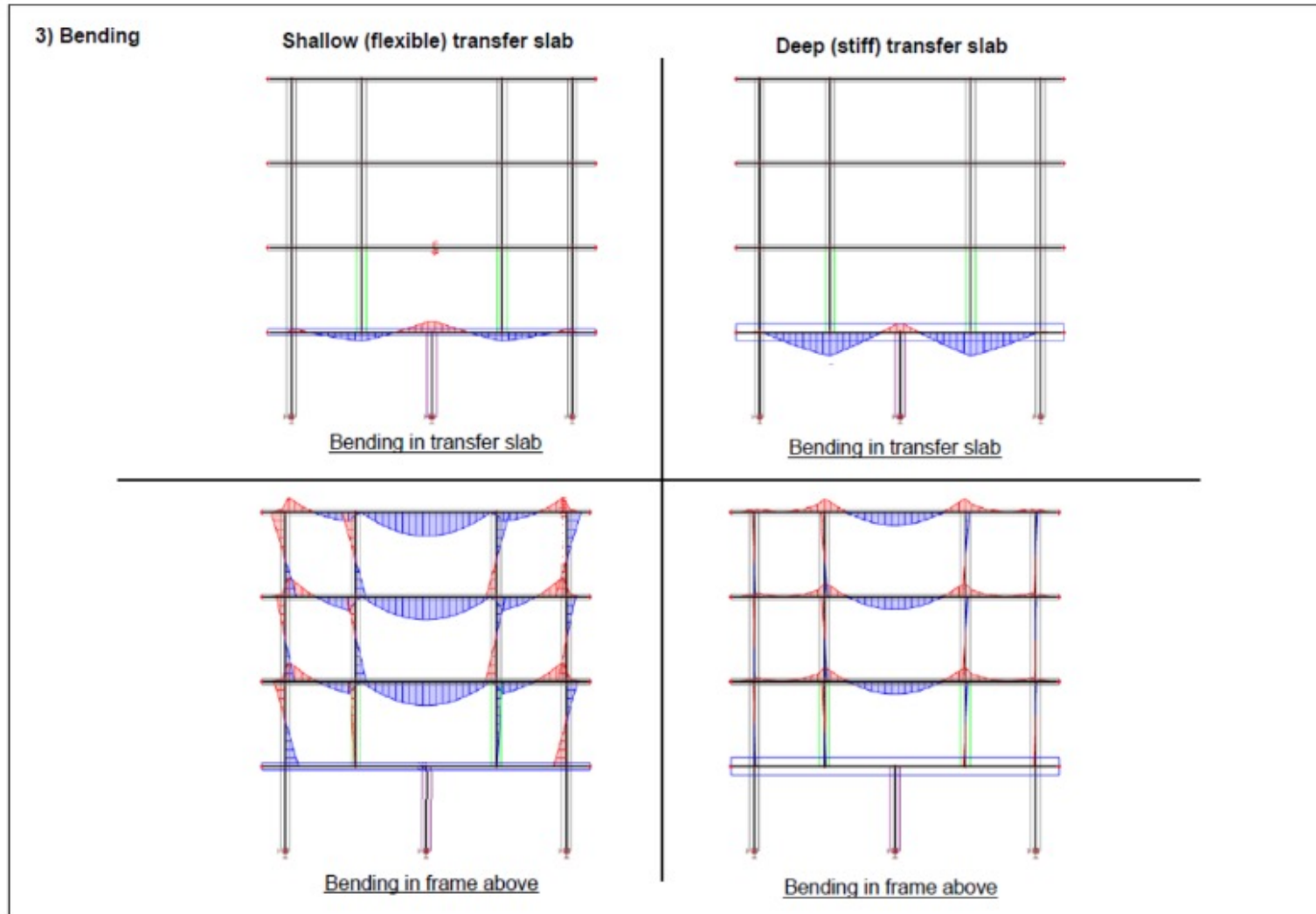


What to look out for: Sizing FE Modelling of Buildings Containing Transfer Slabs



What to look out for: Sizing

FE Modelling of Buildings Containing Transfer Slabs



What to look out for: Sizing

Sizing transfer slab thickness:

Transfer slabs without 'close transfers'

$$d = n \times 100 \geq 250 \quad (1 \leq n_{\text{storeys}} \leq 10)$$

$$250 + (n_{\text{storeys}} \times 75) \quad (n_{\text{storeys}} > 10)$$

Where:

- d = required effective depth of transfer slab (in mm)
- n = number of storeys supported by the transfer slab

Anchorage

$D = 600\text{-}800\text{mm}$

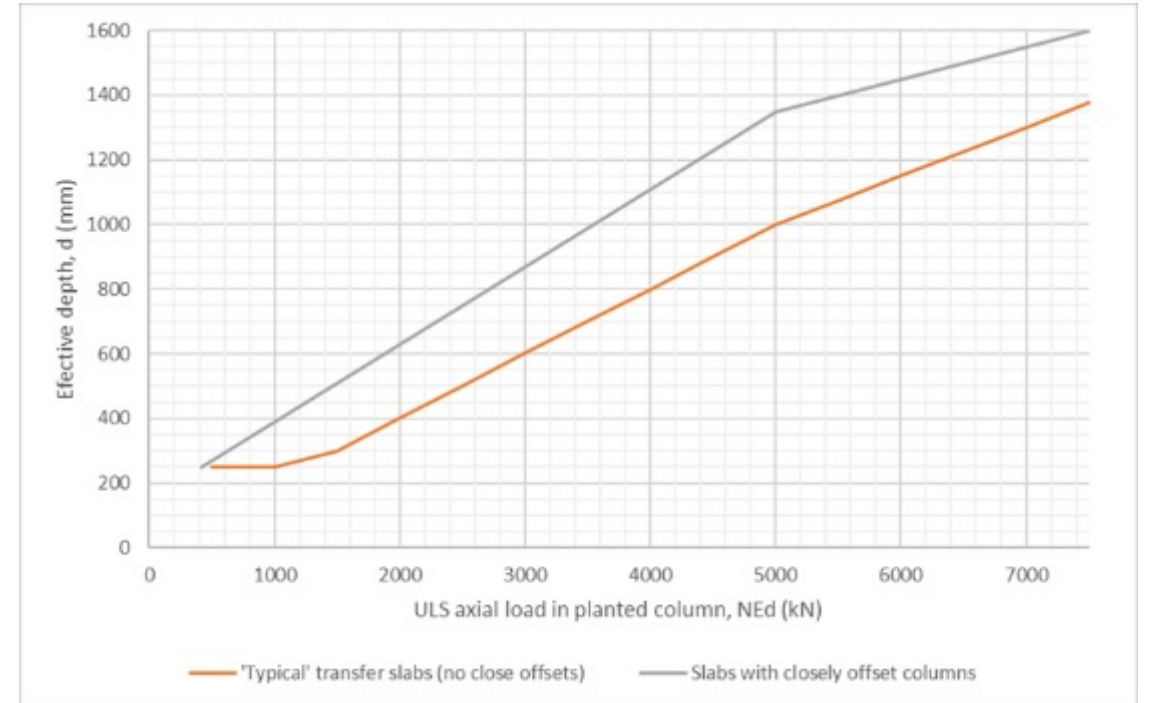
Required overall slab depth, $h = d + 75\text{mm}$

This is only an initial estimate for space planning, not a substitute for detailed consideration of the detailed slab behaviour

Slabs may have been undersized due to

- Not considering shear
- 3-D analysis underestimating transfer loads

Transfer slabs with 'close transfers' (where $S < 0.2L$)



$$d = 150 + (0.25 \times N_{Ed}) \geq 250 \quad (N_{Ed} \leq 5000\text{kN})$$

$$850 + (0.1 \times N_{Ed}) \quad (N_{Ed} > 5000\text{kN})$$

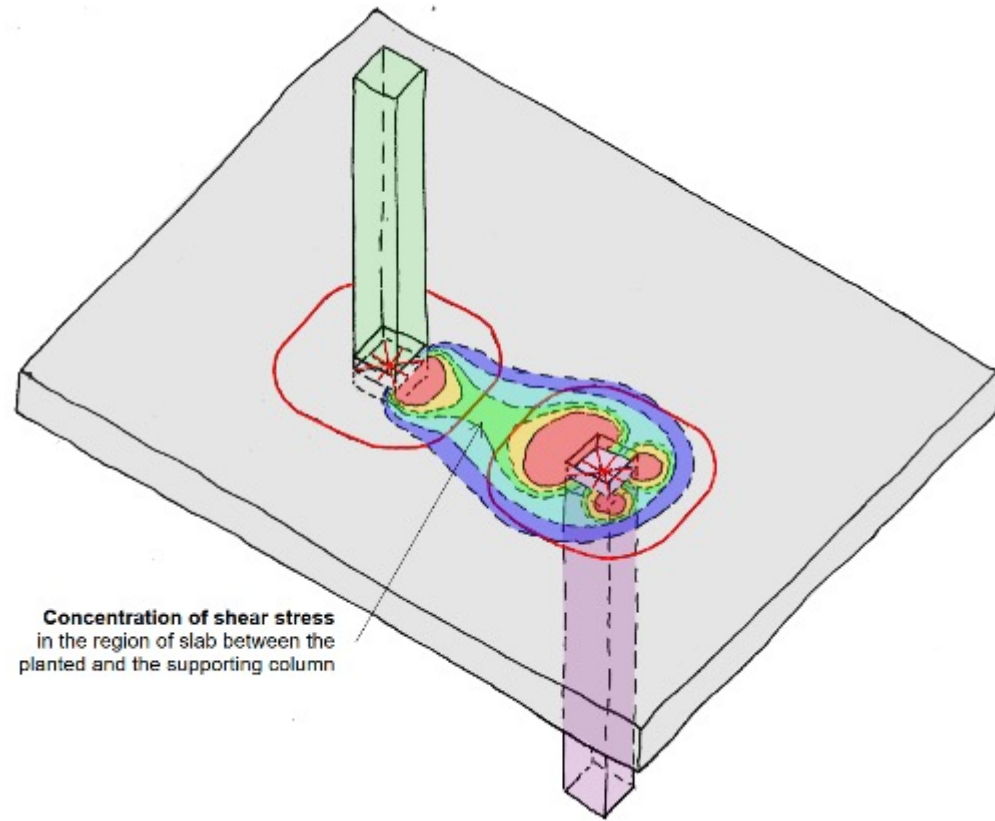
Typical column loads are approx. 750+ kN/floor

What to look out for: Sizing

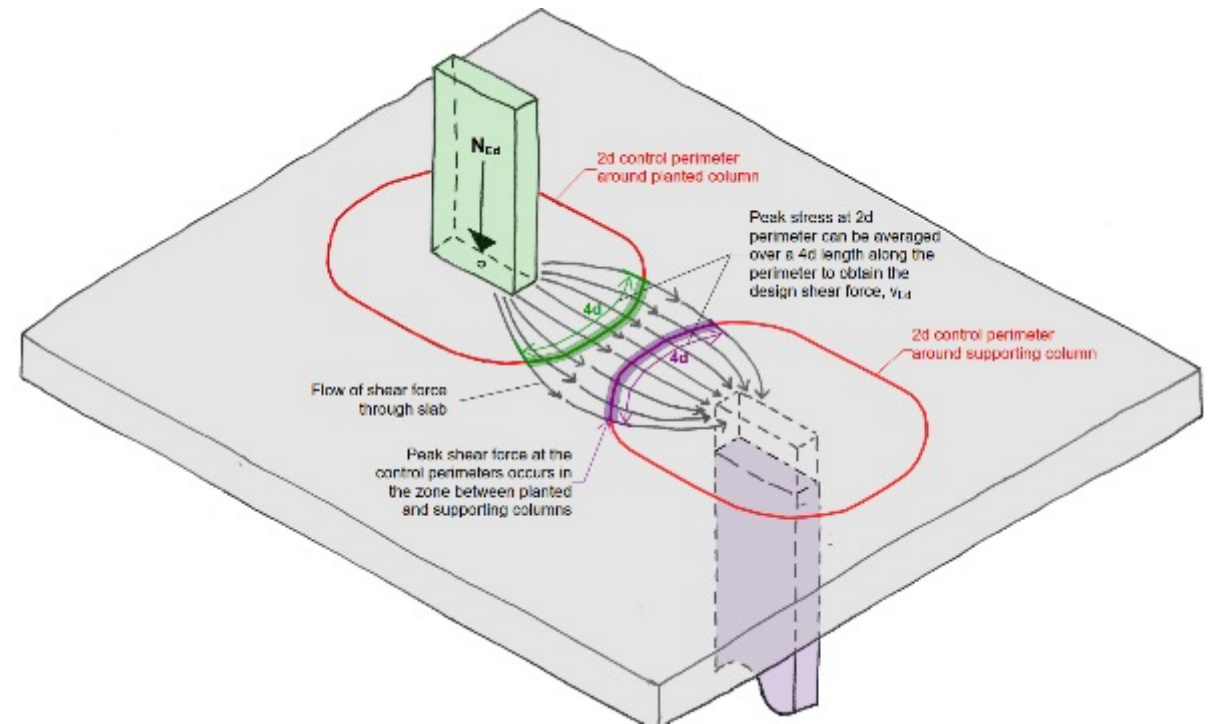
Is the transfer slab thick enough? - Shear

Transfer slabs with 'close transfers'

- Shear resistance of the slab between planted and supporting columns drives depth



shear is normally checked "2d" away from column face. (2 slab depths away).
This is the major topic in the presentation!



Punching shear: Normal slabs

What is its?

How is it assessed?

How it's different in transfer slabs

Punching Shear failure

What is it?

- Slab column junctions can fail by the column puncturing the slab: “Punching Shear”
- Small cracks develop around the column
- The slab fails suddenly with little warning



ACI-fib International Symposium
Punching shear of structural concrete slabs
Punching and post-punching response of slabs
Denis Mitchell, William D. Cook
McGill University, Montreal, Canada

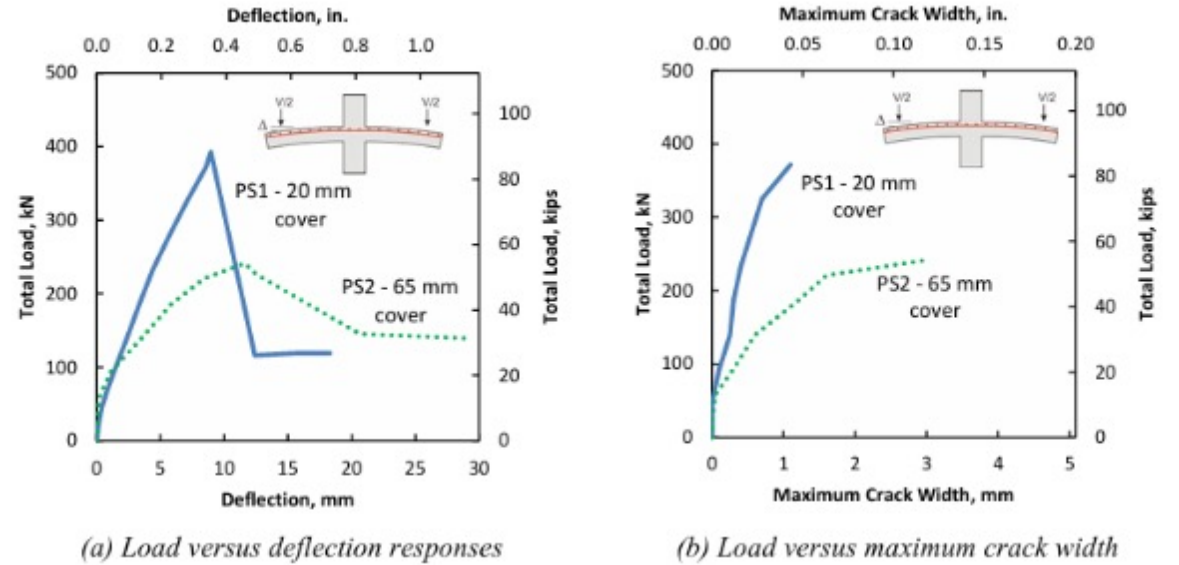


Figure 2: Influence of misplacement on punching shear strength and crack width (test results from Lee et al., 1979).

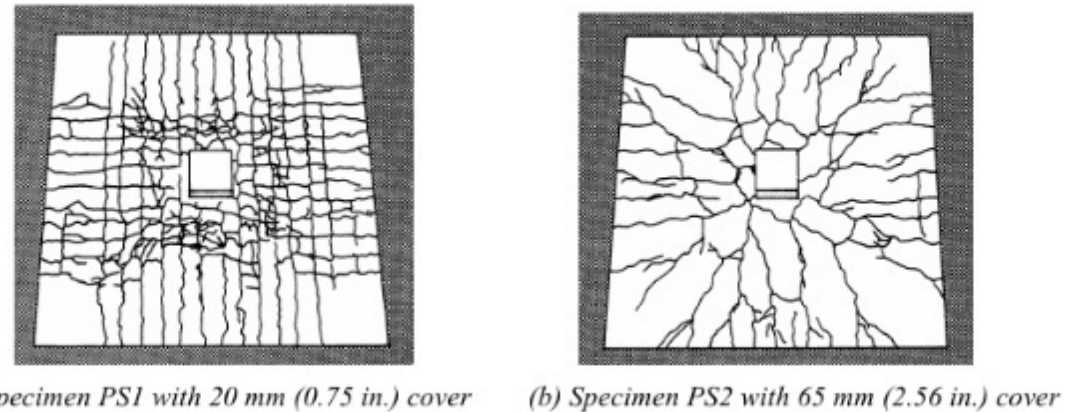


Figure 3: Influence of misplacement of top reinforcement on cracking pattern.

Punching Shear failure

What is it?

- Current models are based on “Critical shear crack theory”

ACI-fib International Symposium
Punching shear of structural concrete slabs

The Critical Shear Crack Theory for punching design:

From a mechanical model to closed-form design expressions

Aurelio Muttoni, Miguel Fernández Ruiz
École Polytechnique Fédérale de Lausanne (EPFL), Switzerland

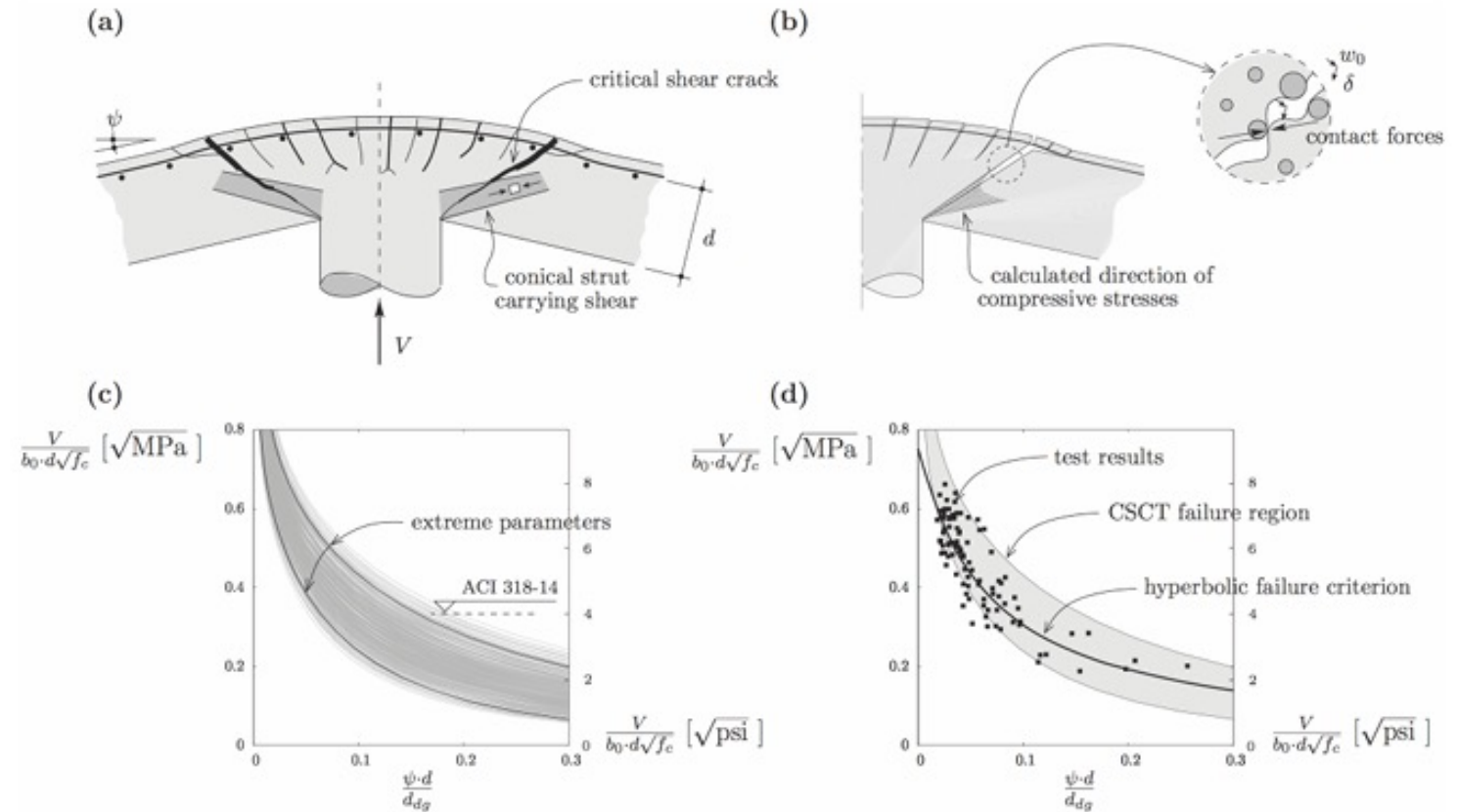


Figure 1: Mechanical approach of the CSCT for punching shear failures: (a) conical strut carrying shear and critical shear crack; (b) numerical integration of the stresses across the failure surface according to Guidotti (2010); (c) numerical results of Guidotti (2010) expressed in terms of the opening and roughness of the critical shear crack; and (d) simplified hyperbolic criterion and comparison to the database presented in Muttoni (2008).

Punching Shear Code Provisions (EC2)

The method is only applicable to uniform loading
And not applicable where columns above/ below are close

- Successive control perimeters checked

- Allowance for bending/ uneven loading

- Simplified rules

6.4 Punching

6.4.1 General

(1)^P The rules in this Section complement those given in 6.2 and cover punching shear in solid slabs, waffle slabs with solid areas over columns, and foundations.

(2)^P Punching shear can result from a concentrated load or reaction acting on a relatively small area, called the loaded area A_{load} of a slab or a foundation.

(3) An appropriate verification model for checking punching failure at the ultimate limit state is shown in Figure 6.12.

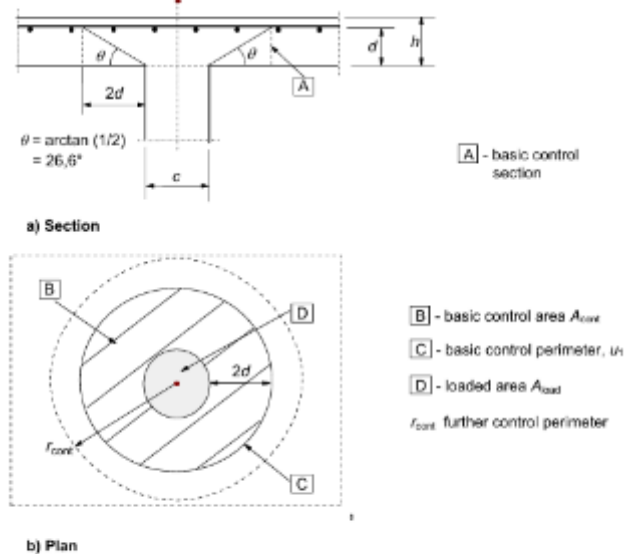


Figure 6.12: Verification model for punching shear at the ultimate limit state

(4) The shear resistance should be checked at the face of the column and at the basic control perimeter u_1 . If shear reinforcement is required a further perimeter u_{cont} should be found where shear reinforcement is no longer required.

Punching shear is a brittle failure mechanism: In a punching shear scenario, the slab may fail before significant redistribution of forces occurs. As such, the designer cannot assume that the shear force transferred into the column will be evenly distributed around the control perimeter – the capacity of the slab needs to be compared to the peak shear that acts around the control perimeter.

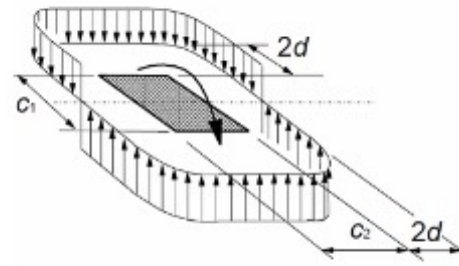


Figure 9: Assumed plastic shear distribution due to unbalanced moments of slabs-to-internal column connection (reproduced from EC2 (2004))

This assumption is acceptable for a typical flat slab where the predominant loading is uniformly distributed. It is not appropriate for transfer slabs: when the slab is subject to heavy point loads, the peak shear force at the control perimeter will not be directly linked to moment transferred to the columns.

To illustrate this, a simple transfer example is considered. A punching assessment will be undertaken in a location where there is a closely offset planted column subject to relatively modest axial loading.

BS EN 1992-1-1:2004+A1:2014
EN 1992-1-1:2004+A1:2014 (E)

(6) For structures where the lateral stability does not depend on frame action between the slabs and the columns, and where the adjacent spans do not differ in length by more than 25%, approximate values for β may be used.

Note: Values of β for use in a Country may be found in its National Annex. Recommended values are given in Figure 6.21N.

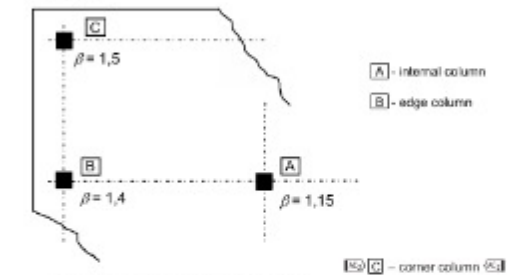


Figure 6.21N: Recommended values for β

(7) Where a concentrated load is applied close to a first slab column support the shear force reduction according to 6.2.2 (6) and 6.2.3 (8) respectively is not valid and should not be included.

(8) The punching shear force V_{ed} in a foundation slab may be reduced due to the favourable action of the soil pressure.

(9) The vertical component V_{ed} resulting from inclined prestressing tendons crossing the control section may be taken into account as a favourable action where relevant.

6.4.4 Punching shear resistance of slabs and column bases without shear reinforcement

(1) The punching shear resistance of a slab should be assessed for the basic control section according to 6.4.2. The design punching shear resistance [MPa] may be calculated as follows:

$$V_{Rd,c} = C_{Rd,c} k (100 \rho_l f_{ct})^{1/3} + k_s \sigma_{sp} \geq (v_{min} + k_s \sigma_{sp}) \quad (6.47)$$

where:

Shear in Transfer slabs

What is its?

How is it assessed?

How it's different in transfer slabs

Shear in Transfer Slabs

Linear Shear

- In wide beams and slabs shear does not fully spread

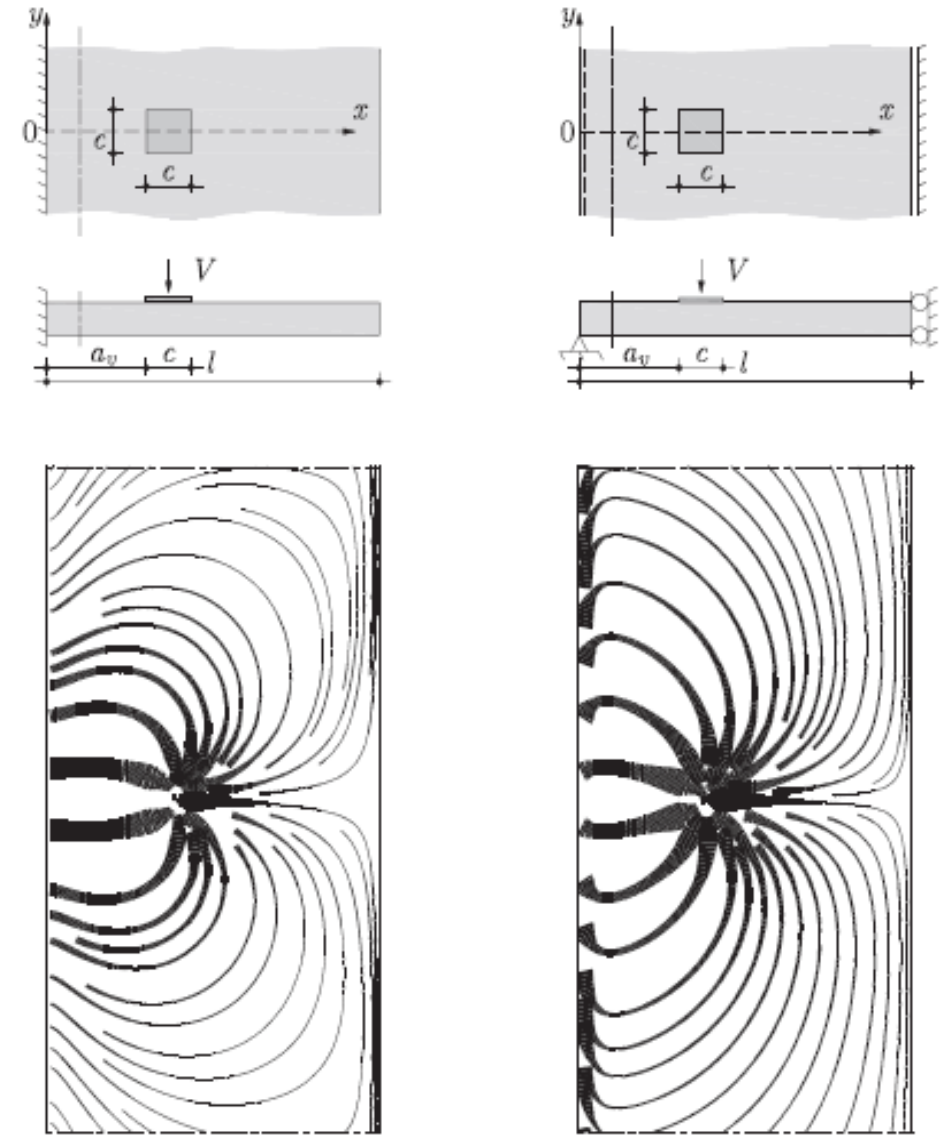
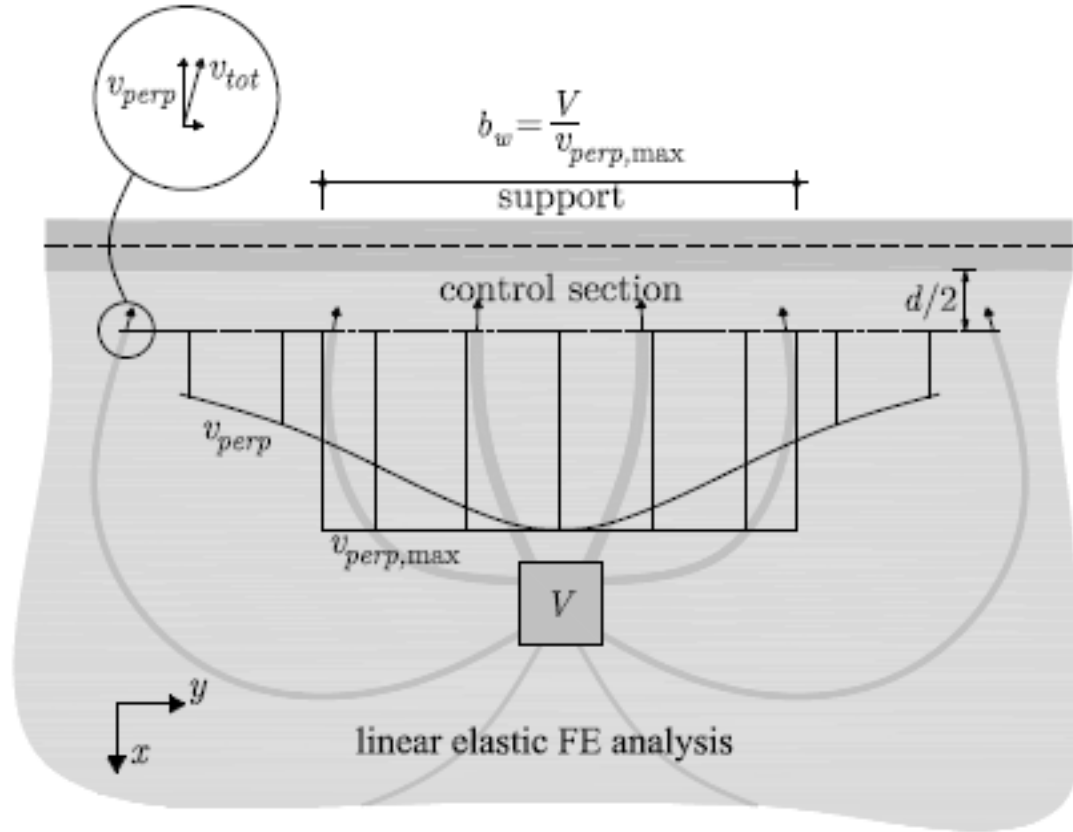
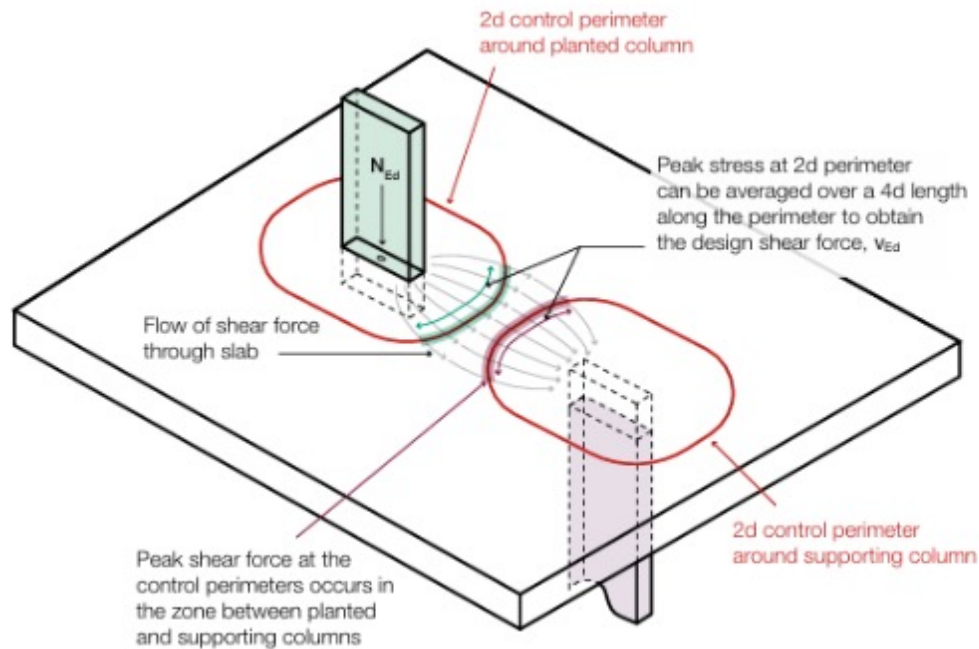


Figure 2.21: Determination of the linear elastic effective width

Shear in Transfer Slabs

Design cases for shear (S = clear gap between planted and supporting columns)

- Based on spacing between supporting & loading columns
- IStructE guidance identifies 4 conditions where special checks are required



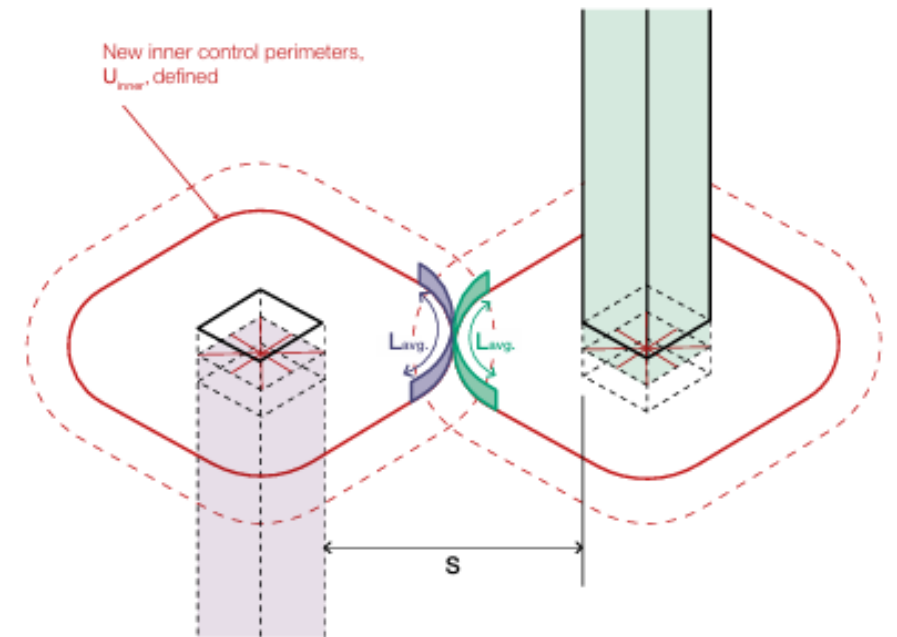
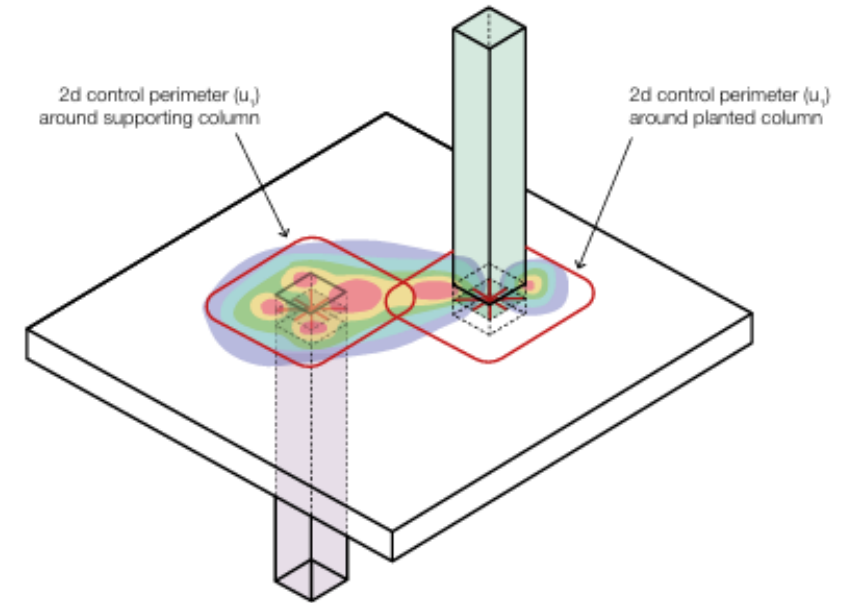
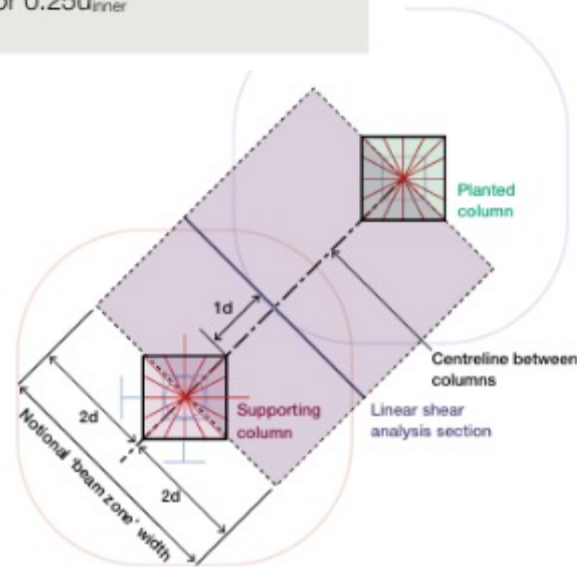
| Design Case | Description of design case |
|-------------------------|---|
| 1 $S > 4d$ | 2d control perimeters around planted and supporting columns do not overlap. The planted and supporting columns can be assessed as separate cases. |
| 2 $1.5d \leq S \leq 4d$ | 2d control perimeters around planted and supporting columns overlap. In order to assess the planted and supporting columns as separate cases, new control perimeters need to be defined which are closer to the column face and do not overlap. |
| 3 $0 \leq S < 1.5d$ | The shear transfer must be assessed by considering a strut and tie mechanism . This case is beyond the scope of this guidance. |
| 4 $S < 0d$ | The plan footprint of planted and supporting columns overlap. The predominant force transfer method will be via a direct compression strut in the overlapping zone. This case is beyond the scope of this guidance. |

Shear in Transfer Slabs

Design case 2: $1.5d \leq S \leq 4d$

- 2d control perimeters around planted and supporting columns overlap.
- New control perimeters need to be defined which are closer to the column face and do not overlap.

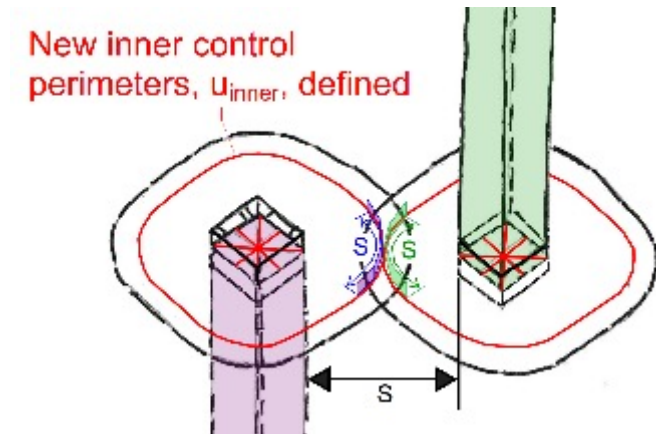
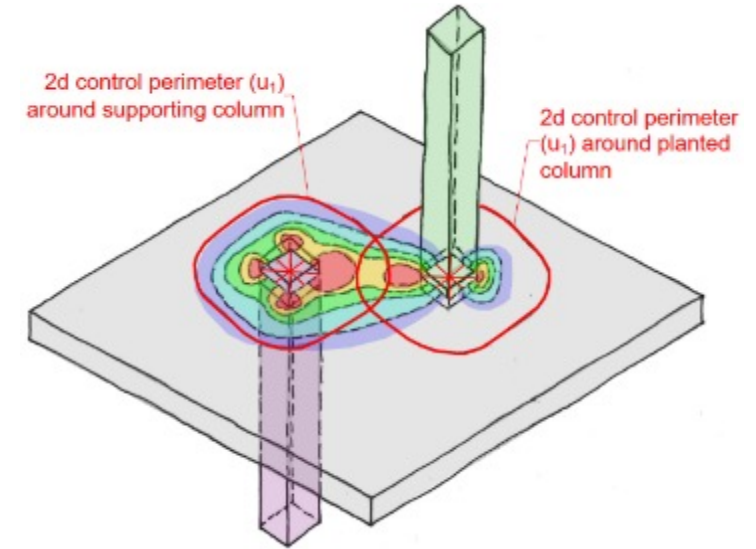
| Column spacing, S | Total averaging length ($L_{avg.}$) permitted is the least of: |
|-------------------|---|
| $2d \leq S < 4d$ | S (S/2 either side of peak) or $0.25U_{inner}$ ($0.125U_{inner}$ either side) |
| $S < 2d$ | 2d (1d either side of peak) or $0.25U_{inner}$ ($0.125U_{inner}$ either side) |



Shear in Transfer Slabs

$1.5d \leq S \leq 4d$: Step 1: Check shear capacity in direct transfer zone based on punching shear model

1. First define u_{inner} perimeters offset $S/2$ from the face of each column such that the perimeters touch at the midpoint between columns.
2. Using an FE model of the transfer slab in isolation, find the peak shear force acting at the inner control perimeter, u_{inner} . This peak is likely to occur at, or close to, where the two inner control perimeters touch.
3. Determine the 'design shear force' per metre, $V_{\text{Ed,inner}}$, at the inner perimeter by averaging around the control perimeter to either side of the peak. The total averaging length permitted is the least of:
 $2d \leq S < 4d$: S ($S/2$ either side of peak) or $0.25u_{\text{inner}}$ ($0.125u_{\text{inner}}$ either side)
 $S < 2d$: $2d$ ($1d$ either side of peak) or $0.25u_{\text{inner}}$ ($0.125u_{\text{inner}}$ either side)



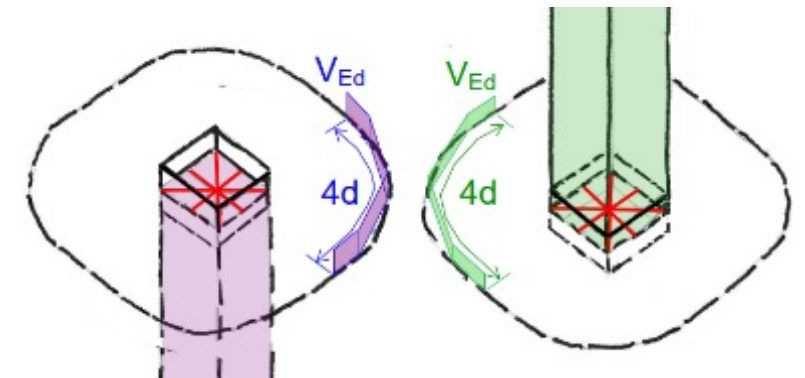
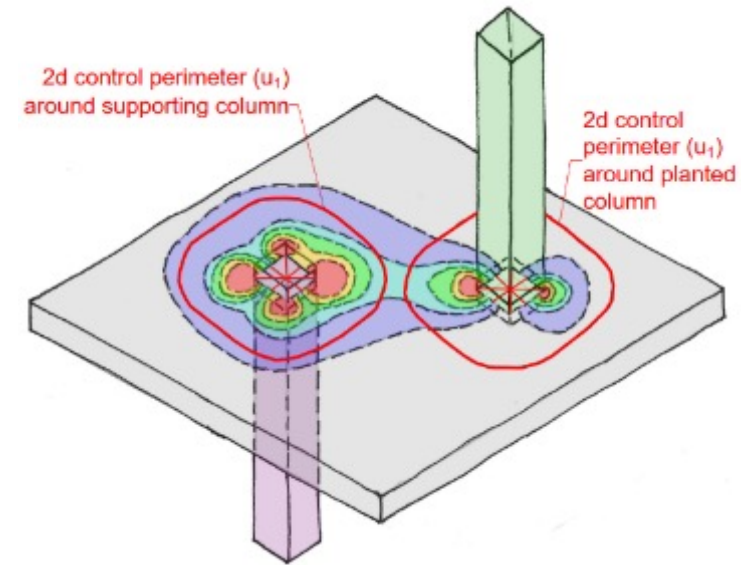
Shear in Transfer Slabs

1.5d ≤ S ≤ 4d: Step 1: Check shear capacity in direct transfer zone based on punching shear model

4. Calculate the EC2 shear capacities of the slabs at the 2d control perimeter, $V_{Rd,c}$, in accordance with BS EN 1992-1-1(2004) (6.4.4), based on the provided flexural reinforcement.
5. Calculate the shear capacity at the inner control perimeter, $V_{Rd,c,inner}$, by modifying the standard EC2 shear capacity: $V_{Rd,c,inner} = V_{Rd,c} \times (u_1/u_{inner})$.

(N.B.: This is NOT a shear capacity enhancement – The equation above simply accounts for the punching shear stress increasing in proportion to the ratio u_1/u_{inner} as the diameter of the control perimeter reduces.

6. Check that the punching shear capacity of the slab is greater than the design shear force at the inner control perimeter. If not, either: increase the flexural reinforcement provided, provide punching shear reinforcement, or increase the slab thickness, as required.

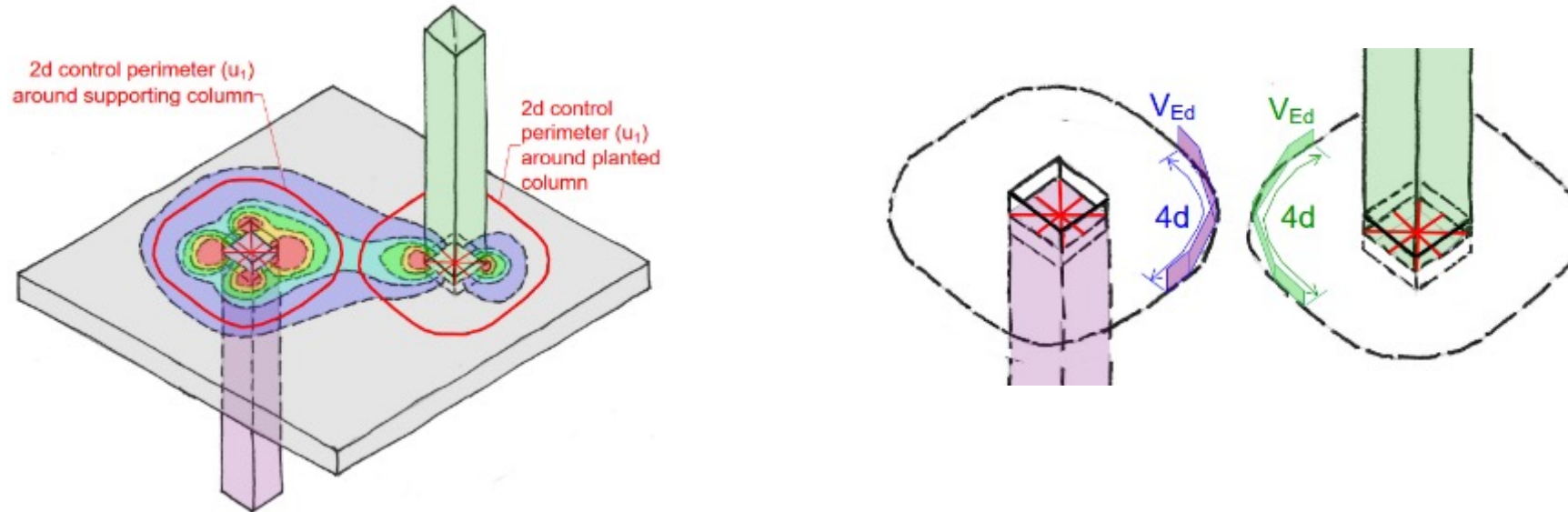


Shear in Transfer Slabs

$1.5d \leq S \leq 4d$: Step 1: Check shear capacity in direct transfer zone based on punching shear model

7. When design shear reinforcement is required, the punching shear capacity of the slab at the inner control perimeter ($v_{Rd,cs,inner}$), $v_{Rd,c}$ should be substituted with $v_{Rd,c,inner}$ and u_1 should be substituted with u_{inner} .

i.e. $v_{Rd,cs,inner} = 0.75 \cdot v_{Rd,c,inner} + 1.5(d/s_r) A_{sw} f_{ywd,ef} [1/(u_{inner} d)] \leq k_{max} \cdot v_{Rd,c,inner}$



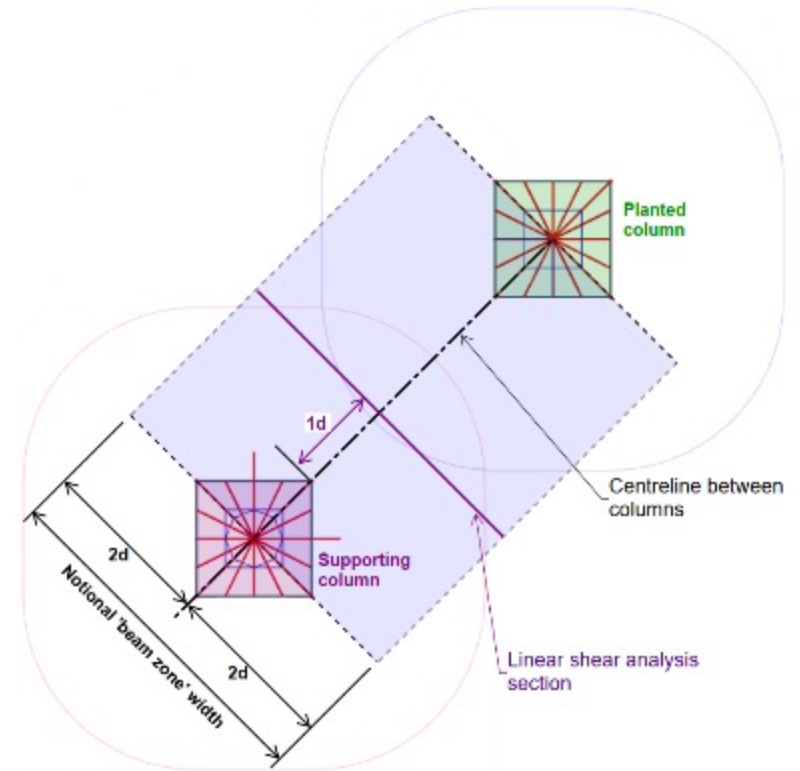
Shear in Transfer Slabs

$1.5d \leq S \leq 4d$: Step 2: Check shear capacity in direct transfer zone based on linear shear model

- Step 2: Check shear capacity in direct transfer zone based on linear shear model
- When the column face-to-face spacing, S , is less than $2d$, the contribution of the planted column point load (N_{Ed}) to the design linear shear force in the slab ($V_{Ed,linear}$) may be reduced by a factor of $(0.5.S/d)$ (in accordance with BS EN 1992-1-1(2023) Cl. 8.2.2 (9)).

The easiest way to achieve this in practice is to reduce the magnitude of the planted column point load in the isolated slab FE model: $N_{Ed,eff} = N_{Ed,ULS} \times (0.5.S/d)$ (for $1.5d \leq S < 2d$).

- Design and detailing of shear reinforcement in the direct transfer zone (if required) as per Step 2 of Design Case 1.



Shear in Transfer Slabs

Design Case 3: $0 \leq S < 1.5d$

- Punching assessment methods are not appropriate
- The shear transfer must be assessed using a *strut-and-tie* (truss) model.
- The appropriate strut-and-tie model for a given transfer location will depend on the specific geometry of the location, so will be project specific.
- Detailed guidance on designing concrete members using strut-and-tie models can be found in the Concrete Centre guide 'Strut-and-tie Models – How to design concrete members using strut-and-tie models in accordance with Eurocode 2'.

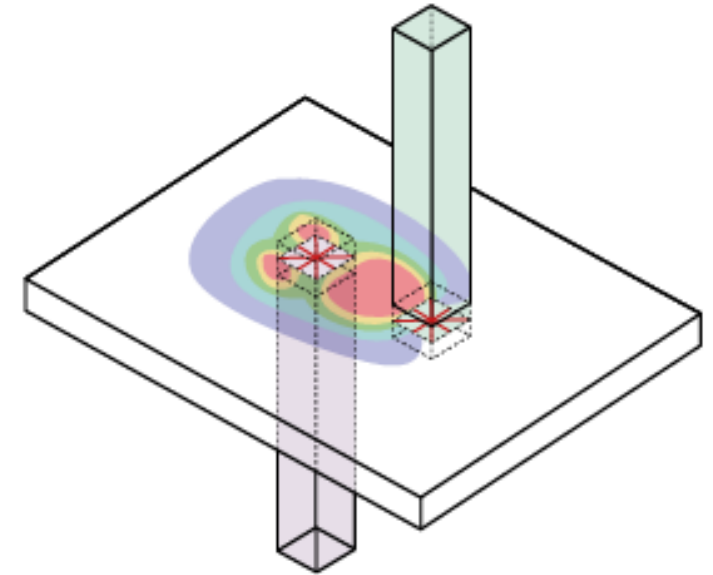


Figure 20: Shear force distribution in slab

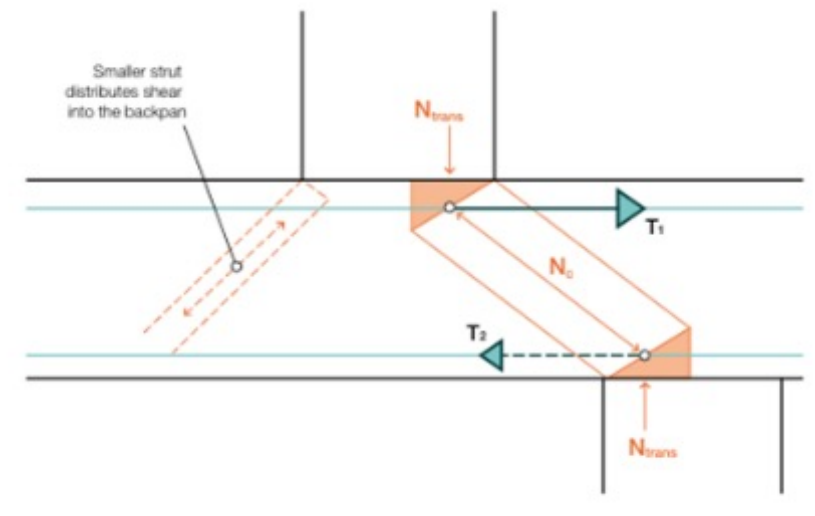
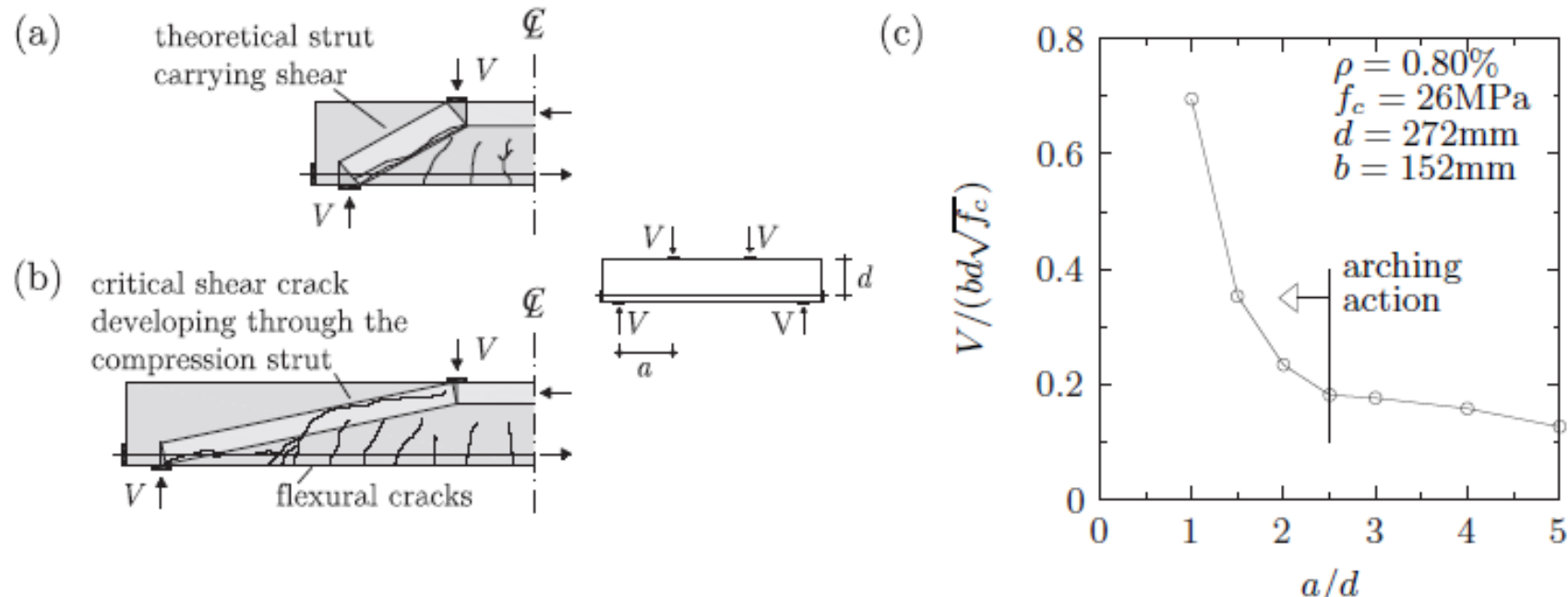


Figure 21: Suggested analysis model

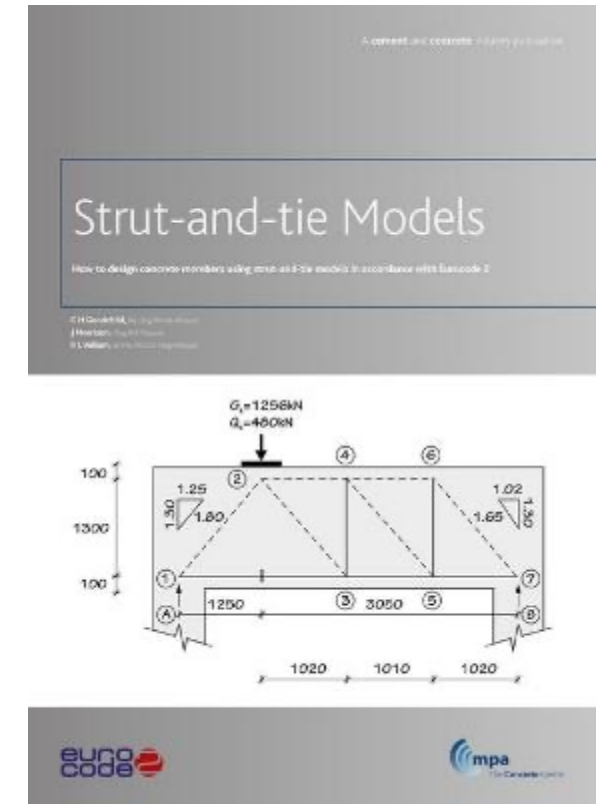
Shear in Transfer Slabs

Design Case 3: $0 \leq S < 1.5d$

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- The appropriate strut-and-tie model for a given transfer location will depend on the specific geometry of the location, so will be project specific.



Comparison of cracking pattern and theoretical direct strut for: (a) small; and (b) larger shear span a (according to [Mut08a]); and (c) shear strength of beams without shear reinforcement tested by Kani (Kan66) as a function of the shear span.



Punching Shear: Transfer Slabs

Design Case 4: $S < 0d$

- The plan footprint of planted and supporting columns overlap.
- The predominant force transfer method will be via a direct compression strut in the overlapping zone.
- This is similar to a “corbel” (covered by EC2)
- A location specific analysis is required
- This case is beyond the scope of IStructE guidance

J.3 Corbels

(1) Corbels ($a_c < z_c$) may be designed using strut-and-tie models as described in 6.5 (see Figure J.5). The inclination of the strut is limited by $1,0 \leq \tan \theta \leq 2,5$.

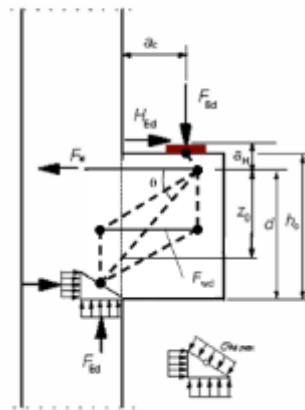
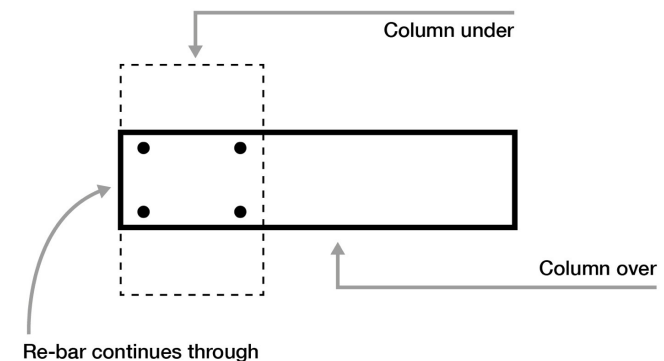
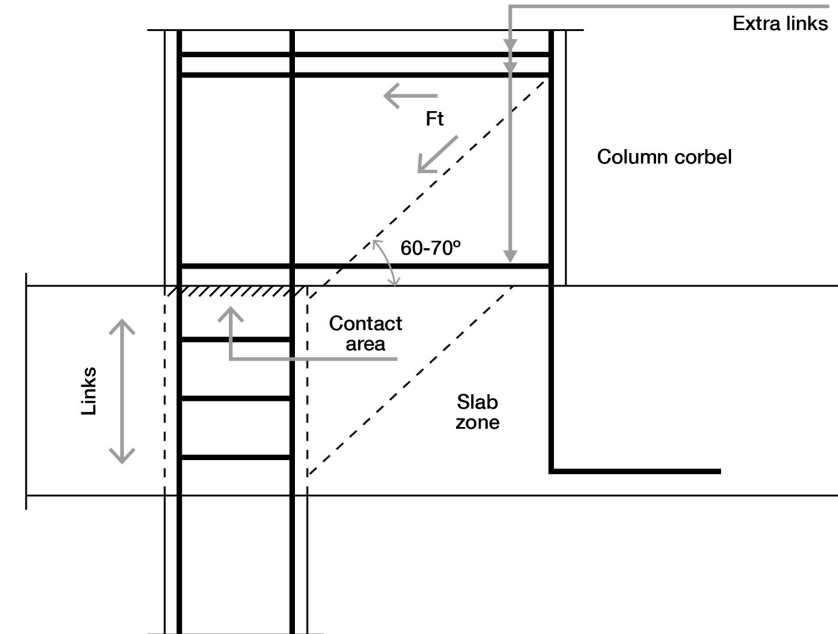


Figure J.5: Corbel strut-and-tie model

Overlapping columns



Assessment of Existing structures

Legal Framework
Technical approach

Assessment of existing Transfer slabs

Legal position

- The issue has now been raised publicly.
- Responsible persons have a duty to be aware of potential safety issues and manage risks.

The screenshot shows a GOV.UK webpage with a blue header. The breadcrumb trail is: Home > Housing, local and community > Planning and building > Building regulation > Potential risks from transfer slabs in buildings. The page title is 'Potential risks from transfer slabs in buildings', published 19 December 2025. It includes a 'Print this page' button and a 'Contents' section with links to 'What transfer slabs are', 'The potential issue with transfer slabs', 'Transfer slabs in residential buildings', and 'What BSR is doing about transfer slabs'. The main text states that the Building Safety Regulator (BSR) is making users aware of a potential structural safety issue affecting reinforced concrete buildings with 'transfer slabs'. It mentions that the BSR is working with industry experts and the Ministry of Housing, Communities and Local Government (MHCLG) to better understand the extent of the risk. A section titled 'What transfer slabs are' explains that a transfer slab is a floor arrangement where a column sits on top of a slab, but does not have a supporting column directly beneath it. Another section, 'The potential issue with transfer slabs', notes that in November 2024, guidance on the design of transfer slabs was published by the Institution of Structural Engineers, raising questions on the adequacy of historic engineering design methods in existing buildings. Specifically, there is a concern regarding "punching shear in transfer slabs," a failure mechanism where a high concentration of load causes a column to punch through a reinforced concrete transfer slab.

Assessment of Existing structures

Legal Framework

General

- The legal requirements differ for HRBs & Non-HRB residential buildings and other buildings
- Claims may also be made under the Defective Premises Act 1972 (DPA)

HRBs

- The majority of buildings affected are likely to be HRBs
- These need to be assessed under the Building Safety Act.

Non HRB Housing Blocks

- A landlord's main repairing obligation is under section 11 Landlord and Tenant Act 1985.
- Section 11 requires landlords to make repairs to the structure and exterior, as well as to installations such as boilers, pipes and electrics.
- It applies to private and social landlords

Other Buildings

- The Health and Safety at Work etc Act 1974 (HSWA) is the primary piece of legislation covering occupational health and safety in Great Britain.
- It sets out the general duties of employers with regards to safety.
- Employers are required by law to protect your employees, and others, from harm.

Assessment of existing Transfer slabs

Legal position

See Tier 1 Tribunal Ruling on investigation & remediation of defective transfer slabs

<https://www.gov.uk/residential-property-tribunal-decisions/block-p-wotton-court-6-jamestown-way-london-e14-2db-lon-slash-00bg-slash-bsa-slash-2025-slash-0006>



FIRST-TIER TRIBUNAL
PROPERTY CHAMBER
(RESIDENTIAL PROPERTY)

Case reference : LON/00BG/BSA/2025/0006

Property : Block P, Wotton Court, 6 Jamestown Way, London E14 2DB
(1) Laura Main
(2) Richard Keeves

Applicants : (3) Vyom Gupta
(4) Nina Rajani
(5) Silas Thebith
(6) Katrina Hill

Respondent : FirstPort Property Services Limited

Type of application : For a remediation order under section 123 of the Building Safety Act 2022
Judge Sheftel
Judge Purcell

Tribunal : Mr Matthew Williams MA MSc
PgDipSurv MRICS

Date : 19 December 2025

DECISION

Summary of Decision

The tribunal makes a remediation order as set out in the annex to this Decision.

Background

- (1) This is an application for a remediation order under section 123 of the Building Safety Act 2022 ("BSA").
- (2) The application relates to the building known as Block P, Wotton Court, 6 Jamestown Way, London E14 ("Block P, Wotton Court")

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Assessment of existing transfer slabs

Technical Framework

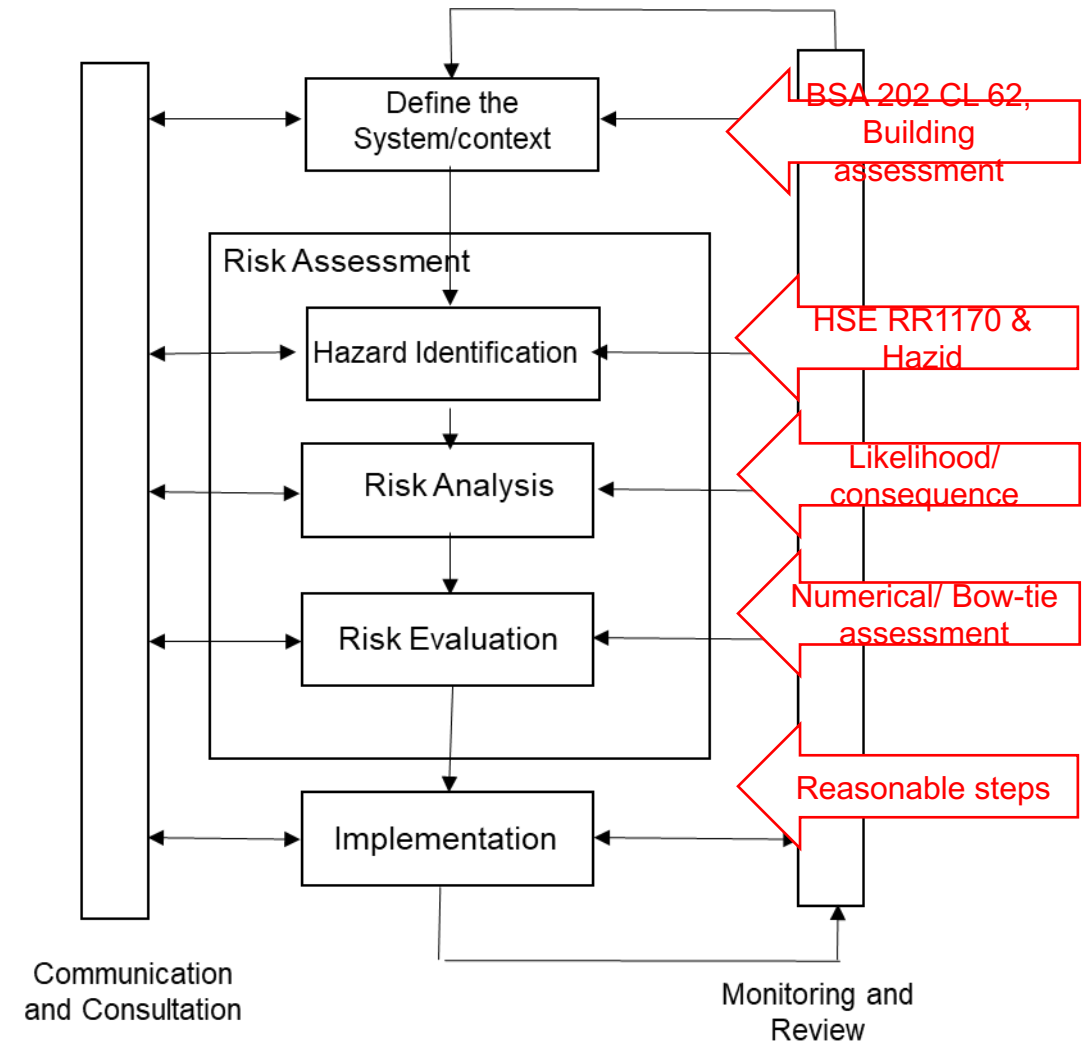
- “Design of Transfer slabs” can also be used to assess existing structures
- The assessment process is set out in IStructE guidance “*Preparing safety case reports for higher-risk buildings under the Building Safety Act: guidance for structural engineers*”
- Structures may need to be back-analysed dependant on the original design approach
- As the issue applies to modern buildings record drawings should be available. This is critical to determine if shear links are present
- Where record information is not available, physical inspection may be difficult or inconclusive.
- A risk-based approach may be required:
 - Ongoing monitoring
 - Control changes



Assessment of existing transfer slabs

Structural Risk Assessment Process

- The scope and objectives of the risk assessment are to
 - Identify structural and fire risks to those in and around the building
 - Assess the likelihood and consequences of risks
 - Identify steps taken to mitigate risks
- A risk assessment process is described based on BS EN IEC 31010:2019 “Risk management – Risk assessment techniques” (IEC 31010:2019)



Flow-chart for the general risk assessment process. (IEC 31010:2019)

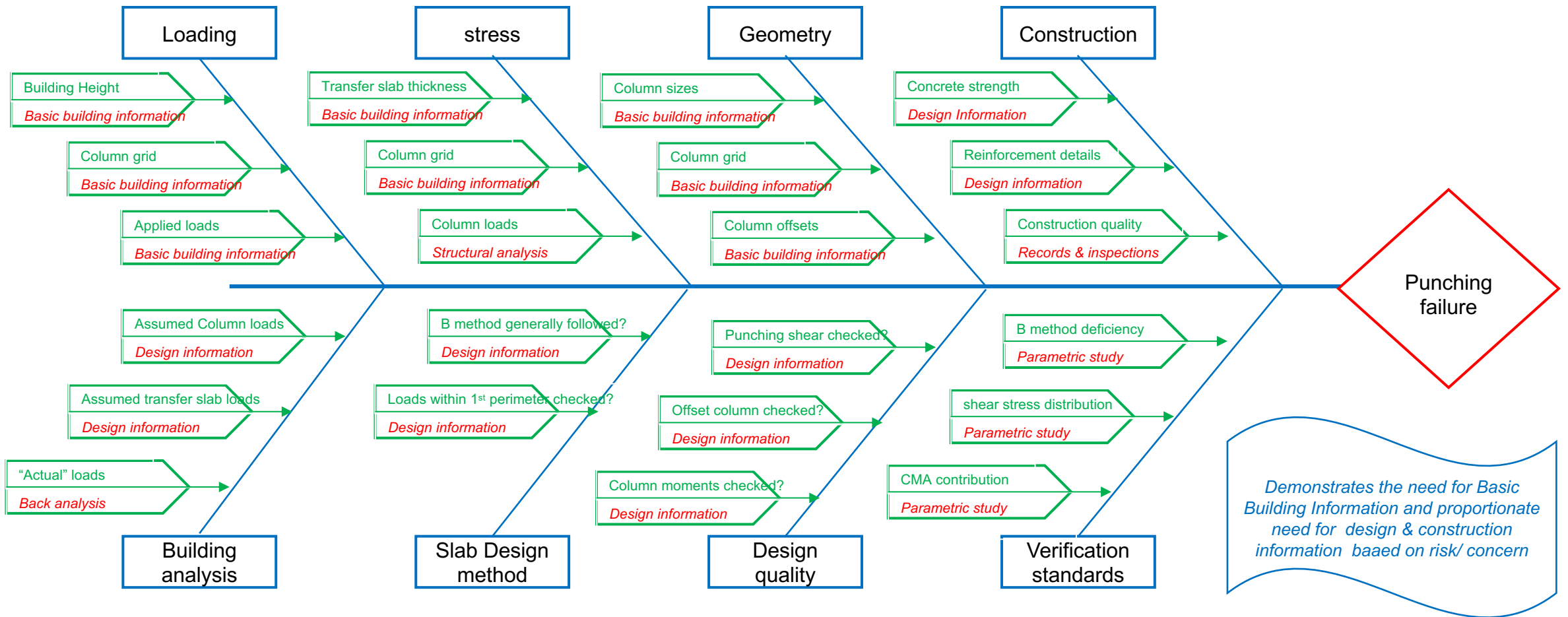
Assessment of existing transfer slabs

Hazard identification factors

| Factor | Reasoning | Parameter | Notes |
|--------------------------------------|---|---|--|
| Building height | Proxy for loading Increased consequence of failure | Storeys: 2-5 (penthouse) 5-10, 10-15. 15-25, 25+ | B Factor method may become more conservative with height Transfer Slabs unlikely to be used above 25 storeys, |
| Height: transfer slab thickness | Proxy for increase in shear stress | Correlate IStructE guide, but at this stage propose: <ul style="list-style-type: none"> • >90% Green • 70-90% amber • 50-70% Red • < 50% Red critical | |
| Column grid length | Indicates magnitude of load | Upper: 6m-8m Lower; 7.5-9m | Above these, an individual assessment is likely to be needed |
| Column offset | Indicates concentration of load | Column offset (above & below) , 4d And height/ thickness ratios high | |
| Ratio of column load below: above | Indicates concentration of load | | |
| Transfer slab stress | Indicates level of demand | Shear stress to IStructE guide | Based on assumed main reinforcement and absence of shear links |
| Building column load analysis method | indicates if column loads on transfer slab have been currently assessed | Transfer slab thickness? | Vital to assess May require back analysis and testing. |

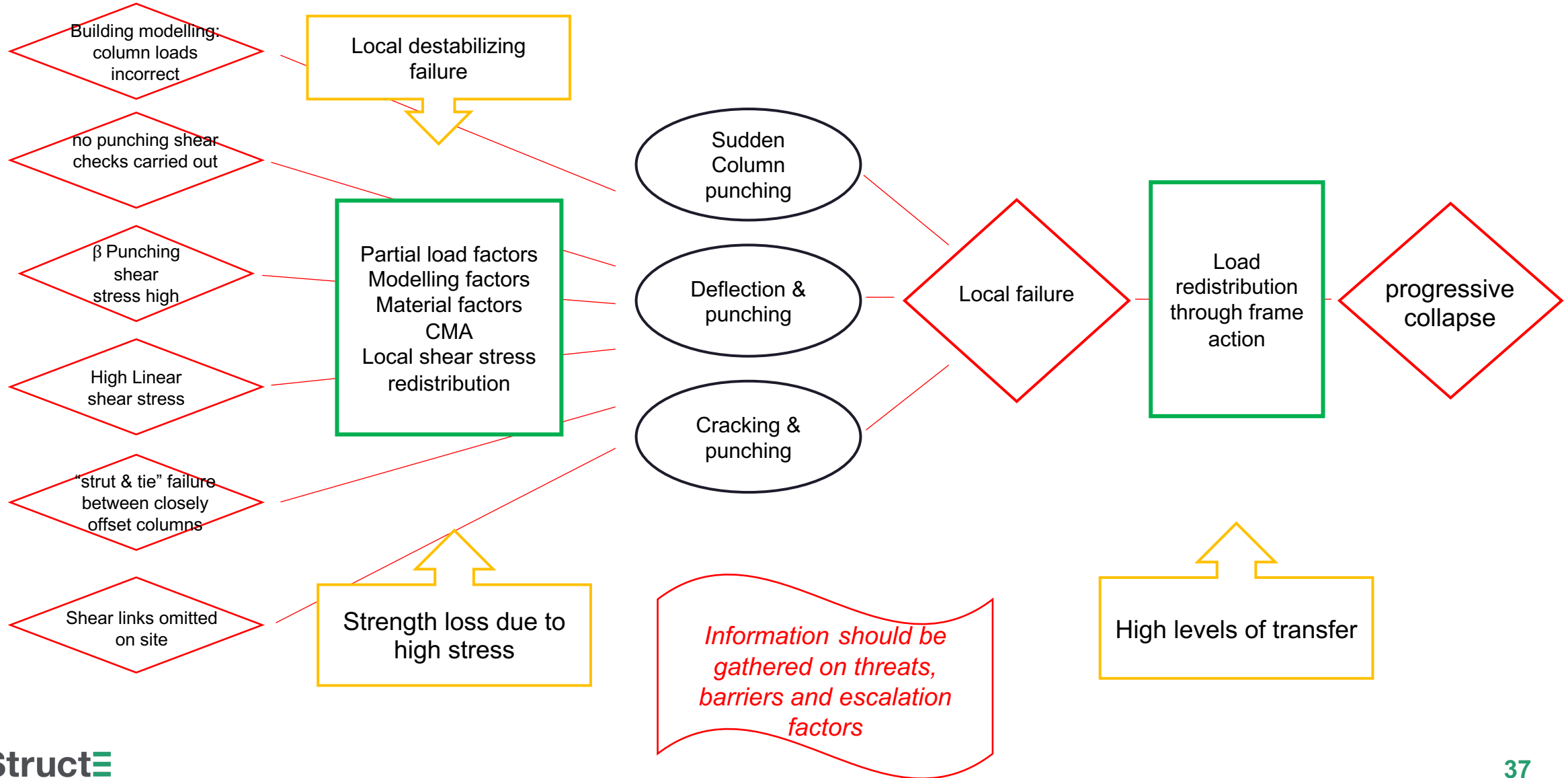
Assessment of existing transfer slabs

Risk assessment method: Decision tree



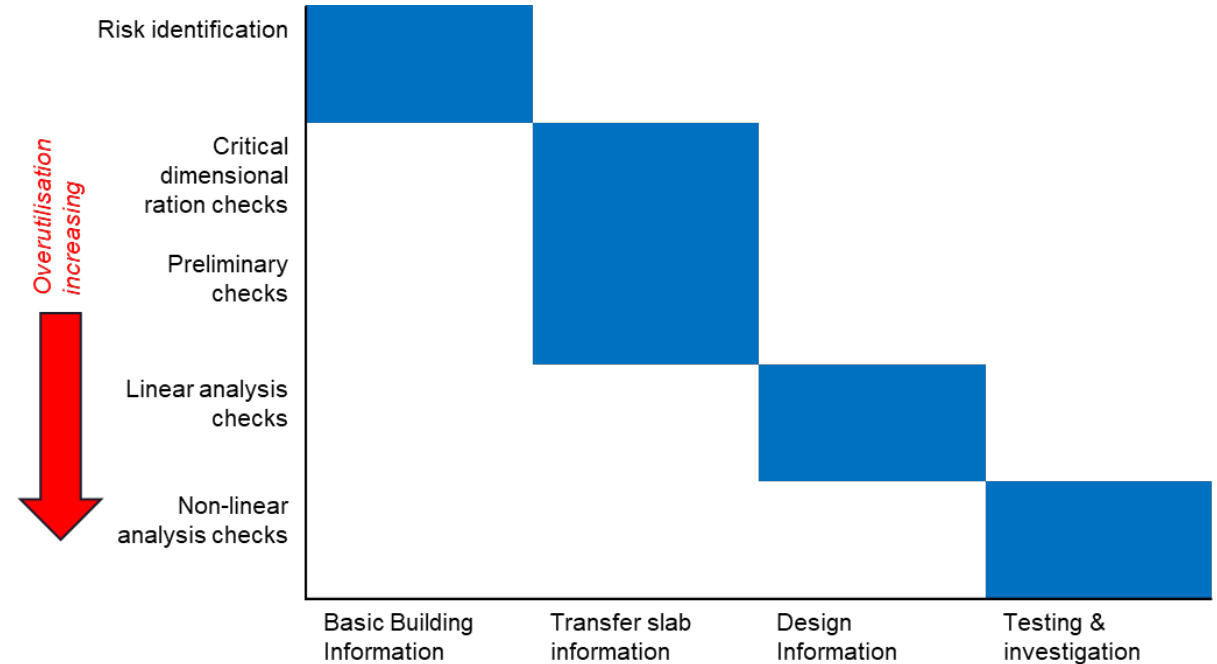
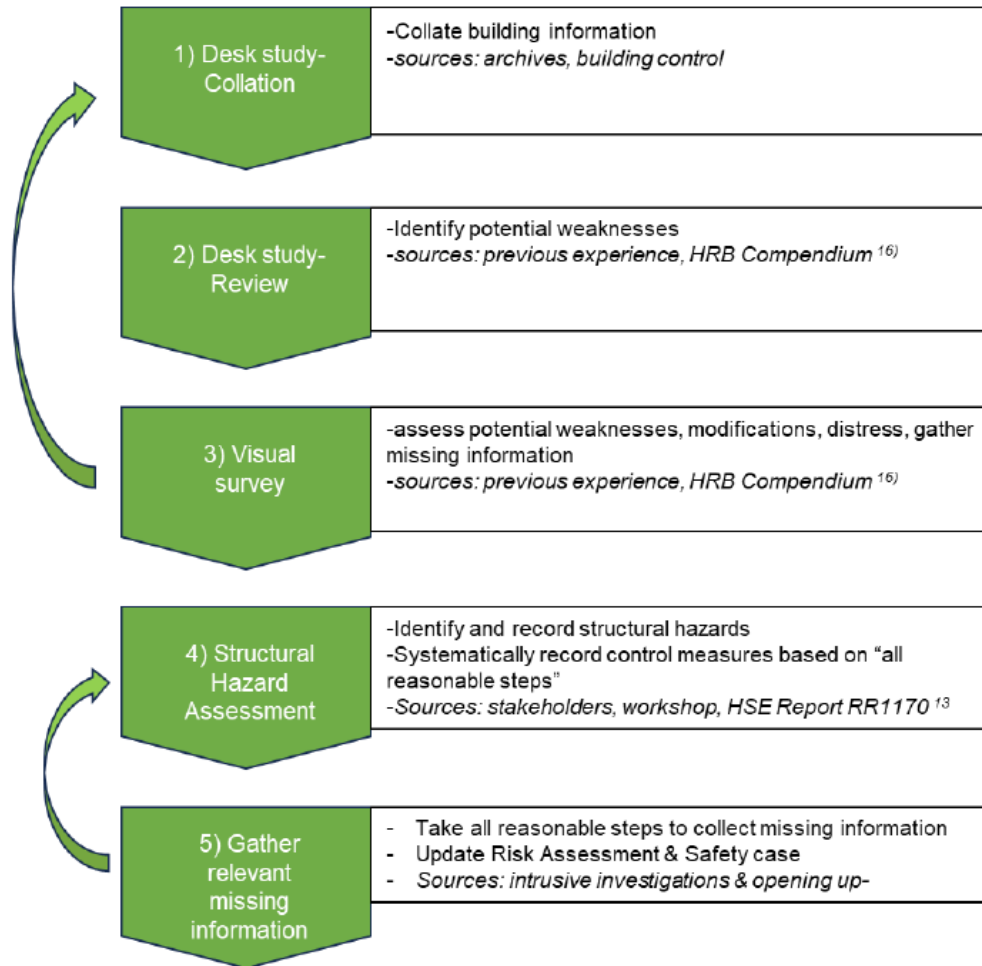
Assessment of existing transfer slabs

Risk assessment method: Bow tie diagram



Assessment of existing transfer slabs

Technical Framework

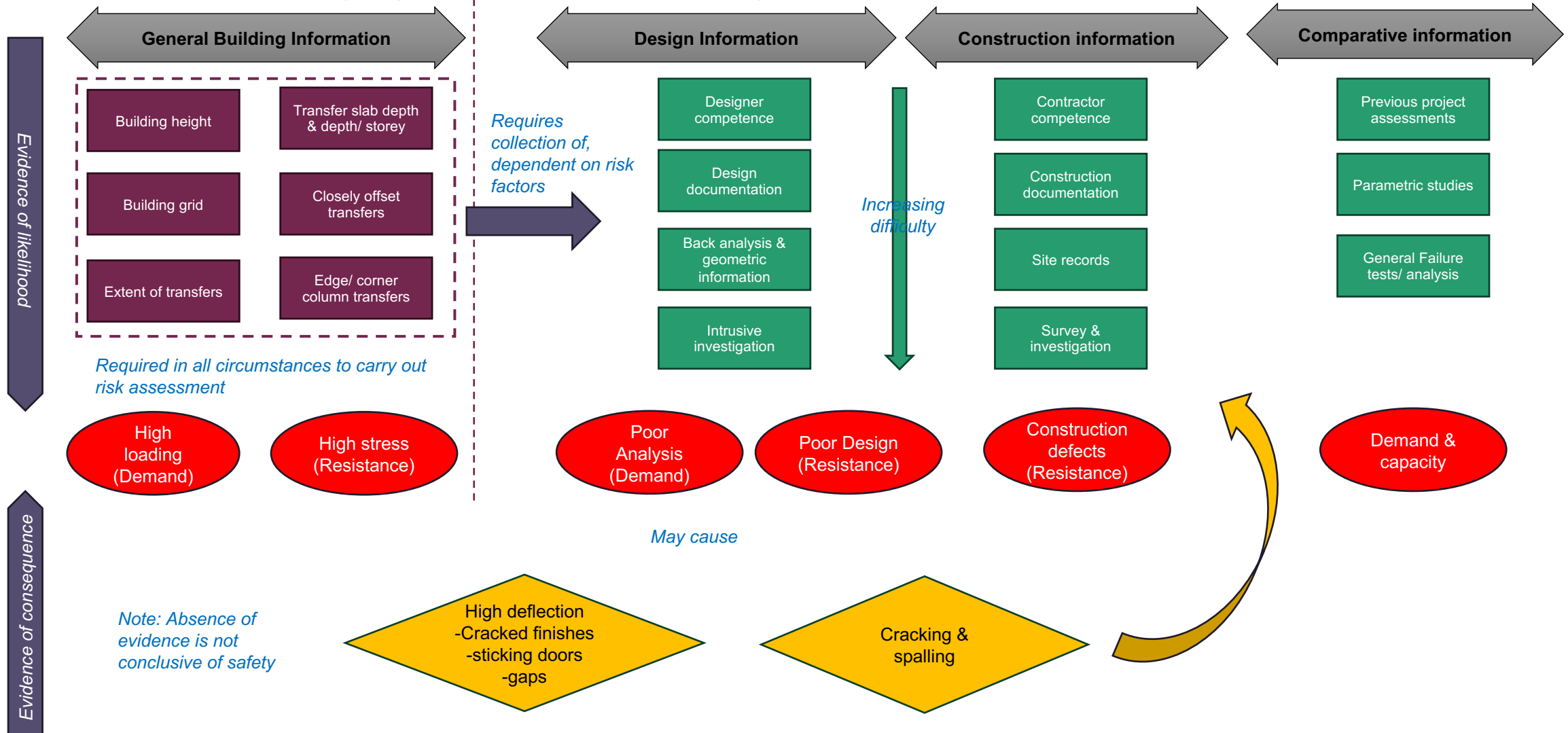


- It is assumed that Basic building information is required to comply with law and assess risk.
- It is recommended that preliminary calculations are carried out on critical elements to ensure that very high stress levels/ levels of demand do not exist

Preparing safety case reports for higher-risk buildings under the Building Safety Act:
IStructE

Assessment of existing transfer slabs

Steps to address varying information availability



Assessment of existing transfer slabs

Acceptability criteria: All reasonable steps

BSR Advice on dealing with legacy issues

Guidance on dealing with legacy issues is given in the BSR presentation to TPI Dec '23 and forthcoming IStructE guidance on safety cases

Features not to current standards

It is possible, even likely, that existing buildings – particularly older ones – will have features and / or measures that were in accordance with the rules and standards in place at the time it was built, but those standards have subsequently changed.

To be clear the law, and BSR, does not require a building to be brought up to the standards required if it were being built today. However, the duty under S.84 to take 'all reasonable steps' and the duty under S.83 to assess building safety risks, should identify and consider such situations and acknowledge any differences. APs should then consider – by gap analysis – the impact of the differences on building safety risks and what, if any, additional measures could be taken. Once they have determined what is possible, they should consider what is reasonable. In some cases, taking steps may be reasonable, even if they only partially address the issue.



Assessment of existing transfer slabs

Acceptability criteria

Where design information is available, “Appraising factors of safety in existing engineered structures” may be used to assess the level of safety

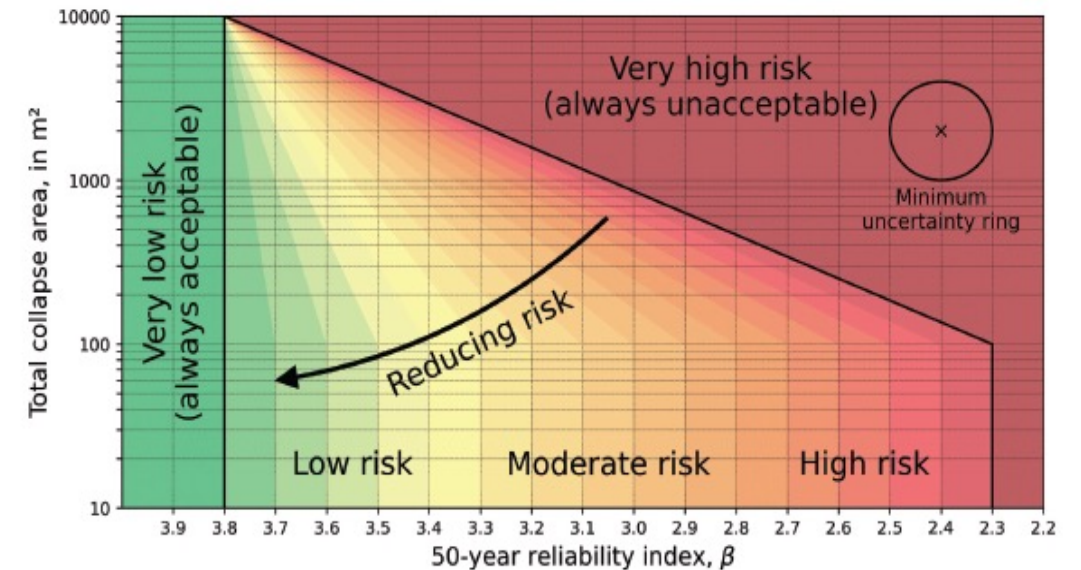
Where design information is missing a risk-based approach could be used with suitable uncertainty, based on assumed insitu conditions

Numerous analyses may be required to test the impact of assumptions on missing information

| Design/ construction quality | Assumed values |
|---|--|
| Good quality design & construction | Assume compliant with codes at time of design |
| Normal quality design & construction | Moderately conservative values/ assumptions |
| Quality unknown | Back-analysis, backed up by limited opening up |
| Known poor quality design/ construction | Determine from opening up |

Design Assumptions

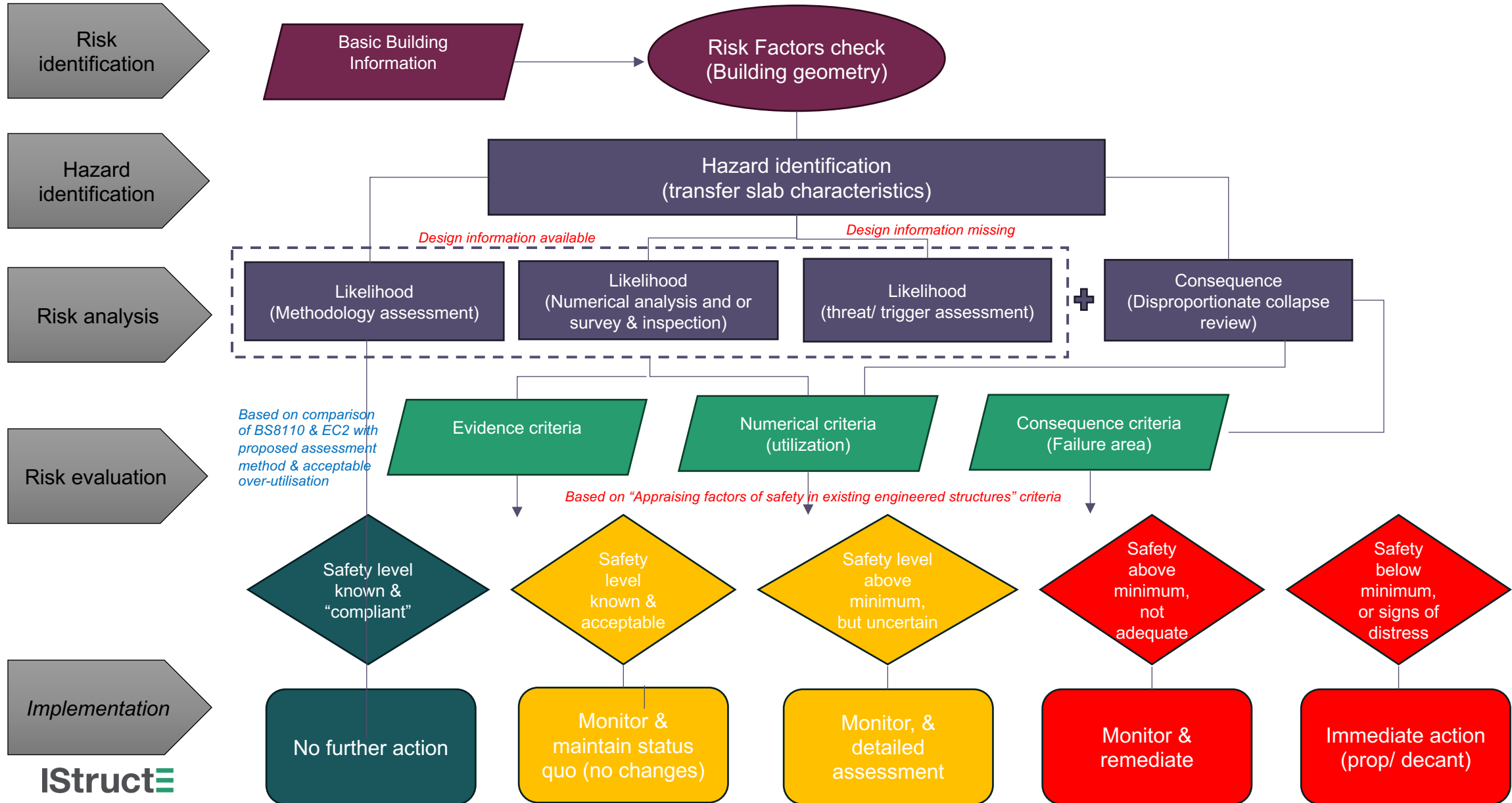
Figure 1: Chart showing spectrum of risk based on reliability index β for different total collapse areas



1. In the UK, structures are generally designed to a target 50-year reliability index of 3.8. Any reliability indices higher than this are therefore always deemed acceptable. A vertical line has therefore been drawn upwards from $b = 3.8$.
2. if the utilisation is equal to the product of the partial factors) the reliability index is between 2.3 and 2.1. Reliability indices in this range are typically only considered acceptable for accidental limit states (where partial factors are set to unity or near unity) so any reliability indices below this are unacceptable.
3. The upper limit on collapse area when assessing accidental actions is “100m² or 15% of the floor area, whichever is less, on two adjacent floors”
4. The upper area limit of 10,000m² corresponds to a scenario where loss of one element could result in the complete loss of a relatively large building. This would clearly be a very severe scenario, and so the element would be expected to have a very low probability of failure.

Assessment of existing transfer slabs

Acceptability criteria & all reasonable steps



Assessment of existing transfer slabs

Further guidance

The Institution is developing guidance on the assessment of existing transfer slab

This will be based on EC2-23 Annex I

It will address:

- Amended verification criteria rules
 - Punching shear
 - linear shear
- Additional design resistance factors
 - Strut and tie action
 - CMA
- Advanced analysis techniques
- Advanced assessment techniques
 - partial factors
 - Materials
- Managing non-compliant slabs
 - Inspection
 - Monitoring
 - remediation

BS EN 1992-1-1:2023
EN 1992-1-1:2023 (E)

tjones@concretecentre.com - 2023-11-28

Annex I (informative)

Assessment of Existing Structures

I.1 Use of this annex

(1) This informative Annex provides supplementary guidance for the assessment of existing structures in plain, reinforced and prestressed concrete.

NOTE 1 National choice on the application of this Informative Annex is given in the National Annex. If the National Annex contains no information on the application of this Informative Annex, it can be used.

NOTE 2 The Eurocodes provide rules that are primarily intended for the design of new structures, although the principles of EN 1990 can also be applied for existing structures, with additional or amended provisions.

I.2 Scope and field of application

(1) This Informative Annex applies to:

- the assessment of existing concrete structures;
- the assessment of the retained parts of existing concrete structures, that are being modified, extended, strengthened or retrofitted, in case of projects where new structural parts are to be combined with retained parts from the existing concrete structures.

(2) This Informative Annex does not apply to design of new structural parts that will be integrated in an existing concrete structure.

(3) This informative annex covers:

- additional rules for materials and system not defined in Clause 5 (e.g. plain bars);
- additional rules for assessing existing structures where detailing does not comply with the provisions in Clauses 11 and 12;
- additional rules for anchorage of plain bars;
- some considerations for deterioration of existing structures.

I.3 General

(1) All clauses of this Eurocode are generally applicable to the assessment of existing concrete structures unless substituted by the provisions given in Annex I.

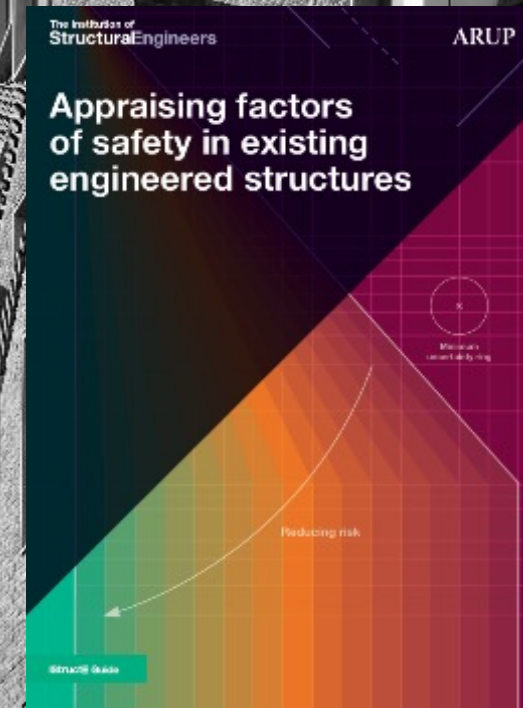
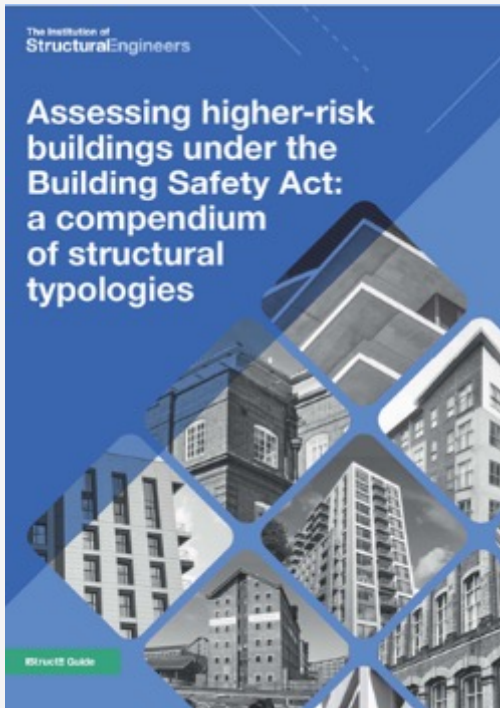
(2) This annex does not provide predictive methods for estimating deterioration rates associated with the various deterioration mechanisms for concrete structures. These should be undertaken using methods specified by the relevant authority or, where not specified, as agreed for a specific assessment by the relevant parties.

(3) Design values determined in accordance with this Eurocode may be interpreted as assessment values for the purpose of Annex I.

(4) The following assumptions apply for the assessment of existing concrete structures:

296

Design and assessment of reinforced concrete Transfer Slabs: Further Guidance



References

- **Slides 17 and 28**

BS EN 1992-1-1: 2004+A1: 2014: Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings. London: BSI, 2014.

Acknowledgement

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- **Slide 15**

Figure 2

Reproduced from *fib* Bulletin 81: Punching shear of structural concrete slabs, Technical Report, page 217 - "Figure 2: Influence of misplacement on punching shear strength and crack width (test results from Lee et al., 1979)" with permission from the International Federation for Structural Concrete (*fib*).

Figure 3

Reproduced from *fib* Bulletin 81: Punching shear of structural concrete slabs, Technical Report, page 217 - "Figure 3: Influence of misplacement of top reinforcement on cracking pattern)" with permission from the International Federation for Structural Concrete (*fib*).

- **Slide 16**

Figure 1

Reproduced from *fib* Bulletin 81: Punching shear of structural concrete slabs, Technical Report, page 239 - "Figure 1: Mechanical approach of the CSCT for punching shear failures: (a) conical strut carrying shear and critical shear crack: (b) numerical integration of the stresses across the failure surface according to Guidotti (2010): (c) numerical results of Guidotti (2010) expressed in terms of the opening and roughness of the critical shear crack; and (d) simplified hyperbolic criterion and comparison to the database presented in Muttoni (2008)" with permission from the International Federation for Structural Concrete (*fib*).

- **Slides 19 and 27**

Maciel Natário, F.M. (2015). *Static and fatigue shear strength of reinforced concrete slabs under concentrated loads near linear supports*. Thèse no 6670. École Polytechnique Fédérale de Lausanne.

Available at: <https://infoscience.epfl.ch/entities/publication/523bef5e-8893-4261-beb2-8656edff55a9> [Accessed: June 2026]

Muttoni, A. and Fernández Ruiz, M. 'Shear strength of members without transverse reinforcement as function of critical shear crack width'. *ACI Structural Journal*, 105(2), 2008, pp163-172

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