

H13 Structural Glass Assemblies

(21.4) Curtain Walls

LSBU Tech 2 Lecture

- **Domestic, Small & Medium size buildings**
- **Construction methods, materials, services and systems**
- **External walls: H13 Structural Glass Assemblies**

THIRD EDITION

PRINCIPLES OF
element
design



Peter Rich &
Yvonne Dean



ARCHITECTURE/DESIGN

PRINCIPLES OF
element
design THIRD EDITION

Peter Rich & Yvonne Dean



- Unique in its approach to detail design
- Invaluable for both students and practising architects, builders and surveyors
- Completely updated in a convenient reference sheet format

The construction of buildings is learnt through experience and the inheritance of a tradition in forming buildings over several thousand years. Successful construction learns from this experience which becomes embodied in principles of application. Though materials and techniques change, various elements have to perform the same function. **Principles of Element Design** identifies all the relevant elements and then breaks these elements down into all their basic constituents, making it possible for students to fully understand the given theory and principles behind each part. As all building projects are subject to guidance through the Building Regulations and British Standards, this book gives an immediate reference back to relevant information to help practitioners and contractors identify key documents needed.

Peter Rich AA (BA) (Hons) Architect, started his career with 14 years' experience as a qualified architectural technician. He then joined the AA School of Architecture, working with Bill Allen and John Bokerdike after his graduation, later becoming a partner of Bokerdike Allen Rich and Partners. He also taught building construction at the Bartlett School of Architecture, University College London, and architectural design at the Polytechnic of North London. He now acts as a Consultant.

Yvonne Dean BA (Hons) BA (Hons) (Hons) is an architect, energy consultant and materials technologist. She also has 15 years' experience as a lecturer, teaches widely and is a guest lecturer at many universities. She pioneered an access course for Women Into Architecture and Building, which has been used as a template by others, and has been instrumental in helping to change the teaching of technology for architects and designers.



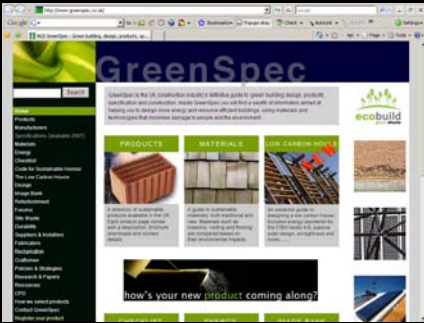
Architectural Press

An imprint of Butterworth-Heinemann
<http://www.bh.com>

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Performance Requirements

Principles of Element Design

Windows Actions

- **Gravity: downward pull**
- **Wind: Motive, Destructive, Penetrative**
- **Rain: Moisture deposition, penetration**
- **Snow: Moisture deposition, loading**
- **Sun: Temp variation, thermal movement, heat gains, Chemical decomposition**
- **Dirt and Dust: infiltration, deposition, surface pollution**
- **Chemicals: corrosion, disintegration, decomposition**
- **Sound: Noise nuisance, from within and from without**
- **Attack: Manual, Ballistics, Bomb Blast**

Windows Reactions

- **Gravity: Support & restraint**
- **Wind: rigidity, resilience, sealing**
- **Rain: deflection, impervious skin, absorption and drainage, sealing**
- **Snow: deflection, impervious skin, absorption and drainage, sealing**
- **Sun: movement joints, insulation, shielding, invulnerable materials**
- **Dirt and Dust: repulsion, exclusion, shielding, cleaning**
- **Chemicals: invulnerable materials, exclusion,**
- **Sound: Insulation**
- **Attack: toughness, lamination, edge restraint, edge protection**

Windows Outside

- Daylight, Sunlight, Glare, Solar Heat gains,
- Sound Insulation
- Fresh air, ventilation and Smoke control
- Wind driven rain and snow
- Privacy from overlooking
- Cleaning
- Security
- Insect exclusion

Windows Inside

- Statutory Ventilation, trickle ventilation
- Thermal insulation, heat losses
- Emissivity
- Comfort conditions
- Views out and eye level
- Safety, Containment, Impact, Balustrade
- Fire
- Statutory Window Area

Structural Design of glass

Partition

Safety Glass:
No shards

Class A
Impact
Performance



Manifestation



Cleaning loading

Wind pressure
buffeting

Floor

Building
Regulations:
BRAD K
Containment

Class A
Impact
Performance



Manifestation



Balustrade
Loading

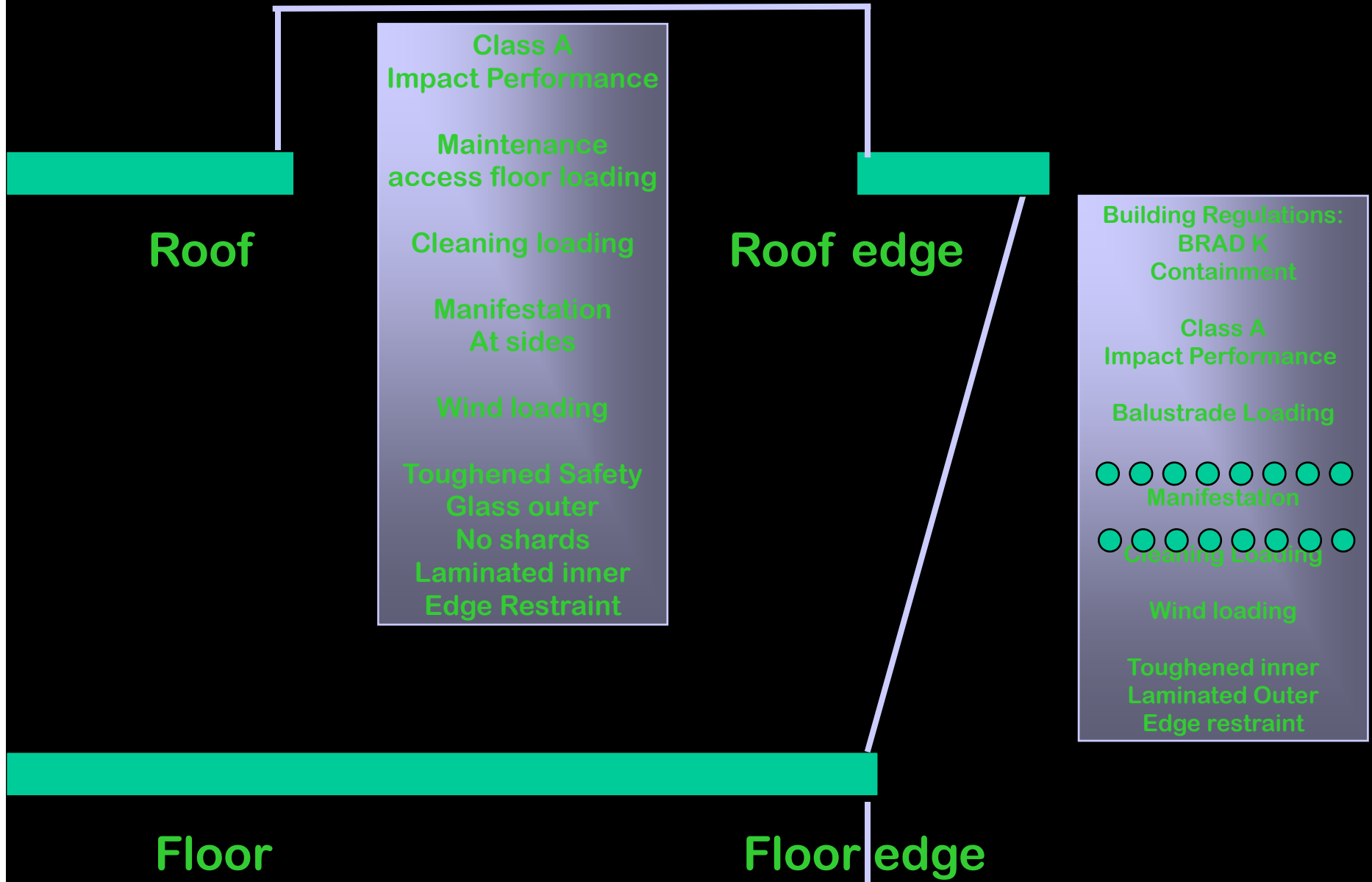
Cleaning Loading

Wind loading

External
Wall

Floor edge

Structural Design of glass



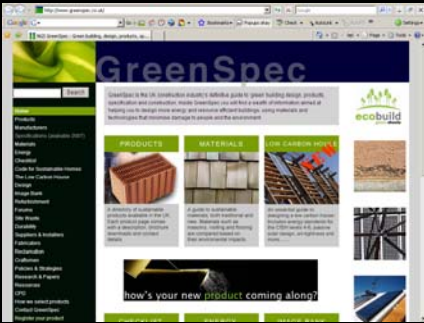
Weather Envelope



**Absorbent – Repellent – Open Joint Panelled
Masonry – Curtain Wall – Rainscreen**

Thermal Bridge?

- Glass is a poor insulator
- Improved with Double and Triple Glazed sealed units or double walls with large void
- Improved with Argon & Pentane gas in sealed unit and non metallic edge spacer
- Improved with Low E Coatings on glass faces
- Stainless steel fasteners through glass
- Its a thermal bridge through which heat is lost
- But stainless steel is a relatively low conductor of heat compared to other metals



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www.greenspec.co.uk

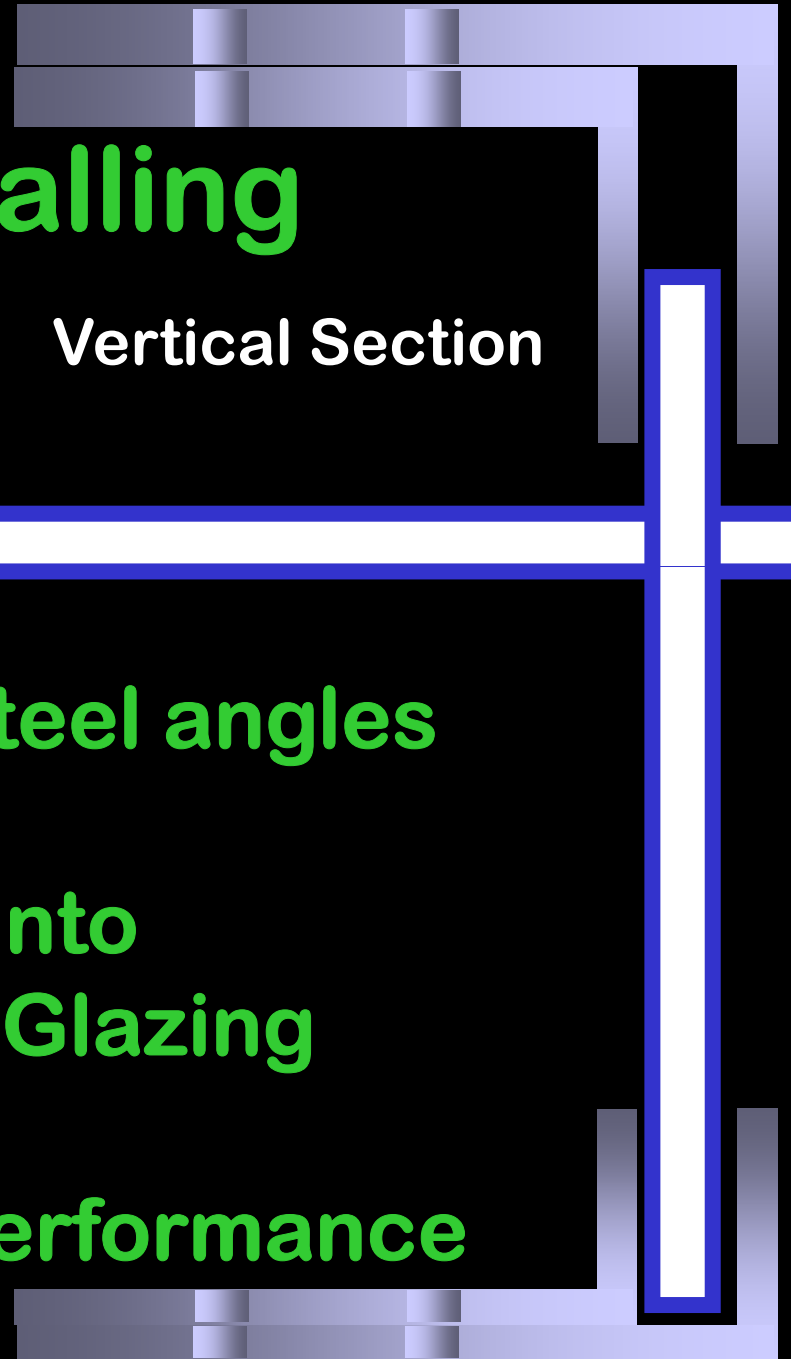
Assemblies

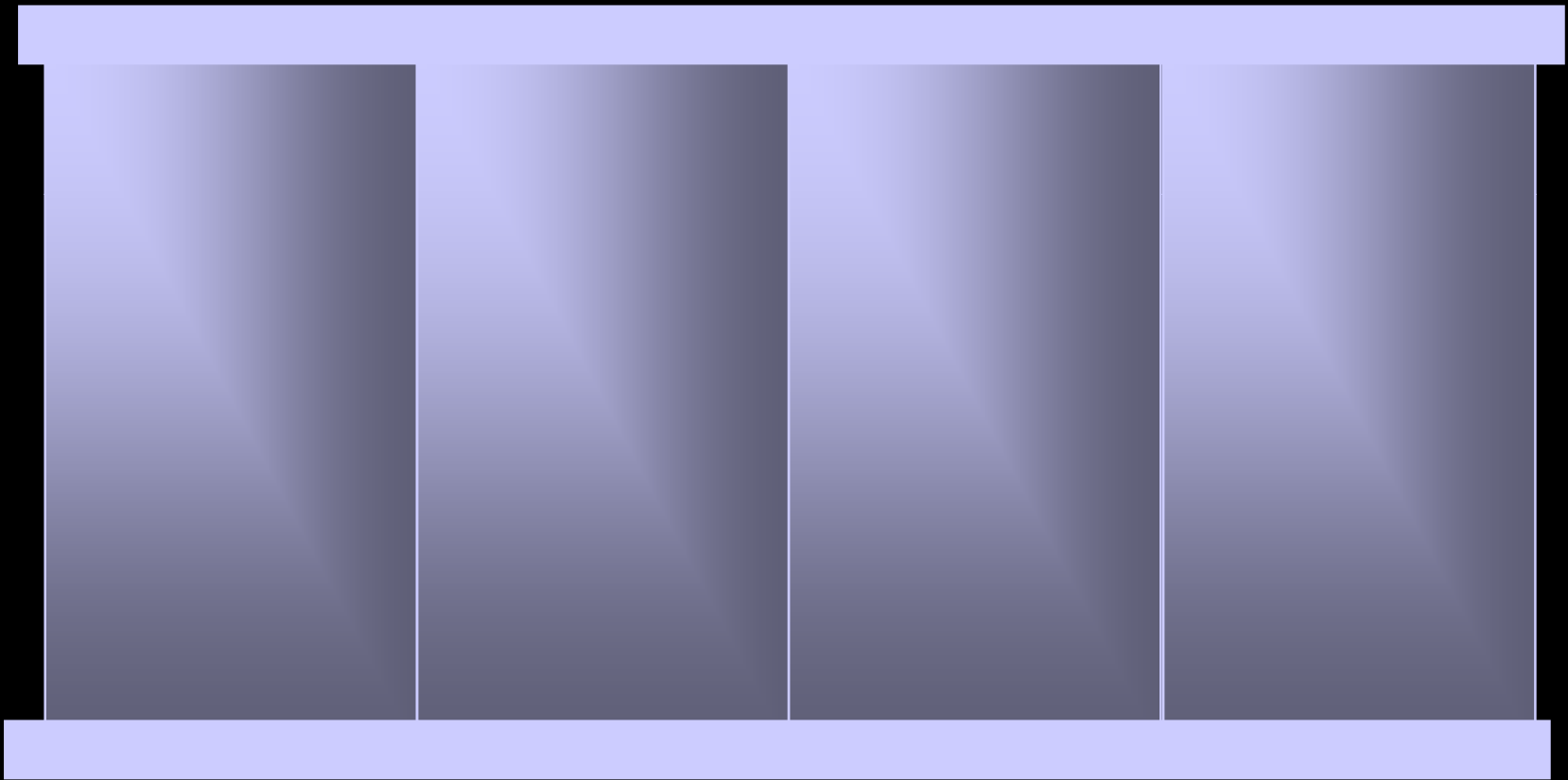
Structural Glass Walling

Plan View

Vertical Section

316 Austenitic Stainless steel angles
Shuffle Glazing assembly
304 ASS Expanding bolts into
Single, Double and Treble Glazing
Toughened Glass
BS 6206 Class A Impact performance
Silicon Sealant Jointing





Structural Glass Fin Walling

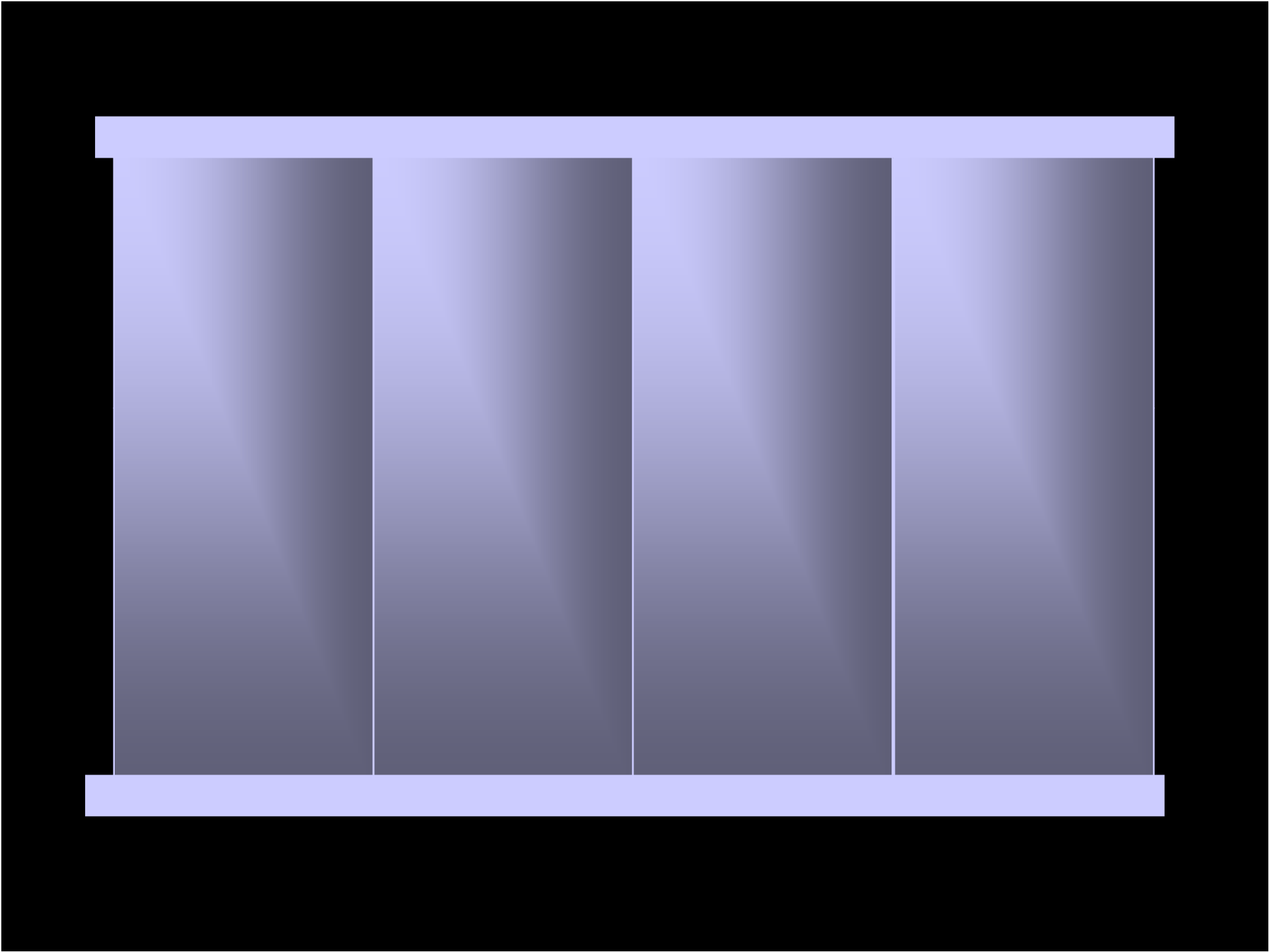
Plan View



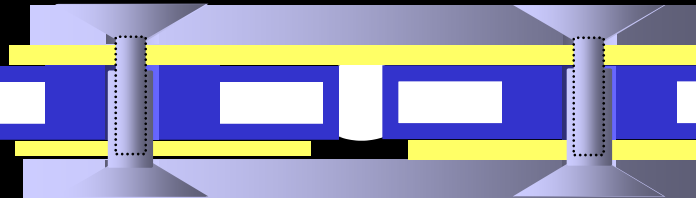
Glass wall, Mullions & Transoms
Marine 316 Austenitic Stainless Steel fixings
& fastenings

Single, Double and Treble Glazing
Toughened Glass

BS 6206 Class A Impact performance
Silicon Sealant Jointing

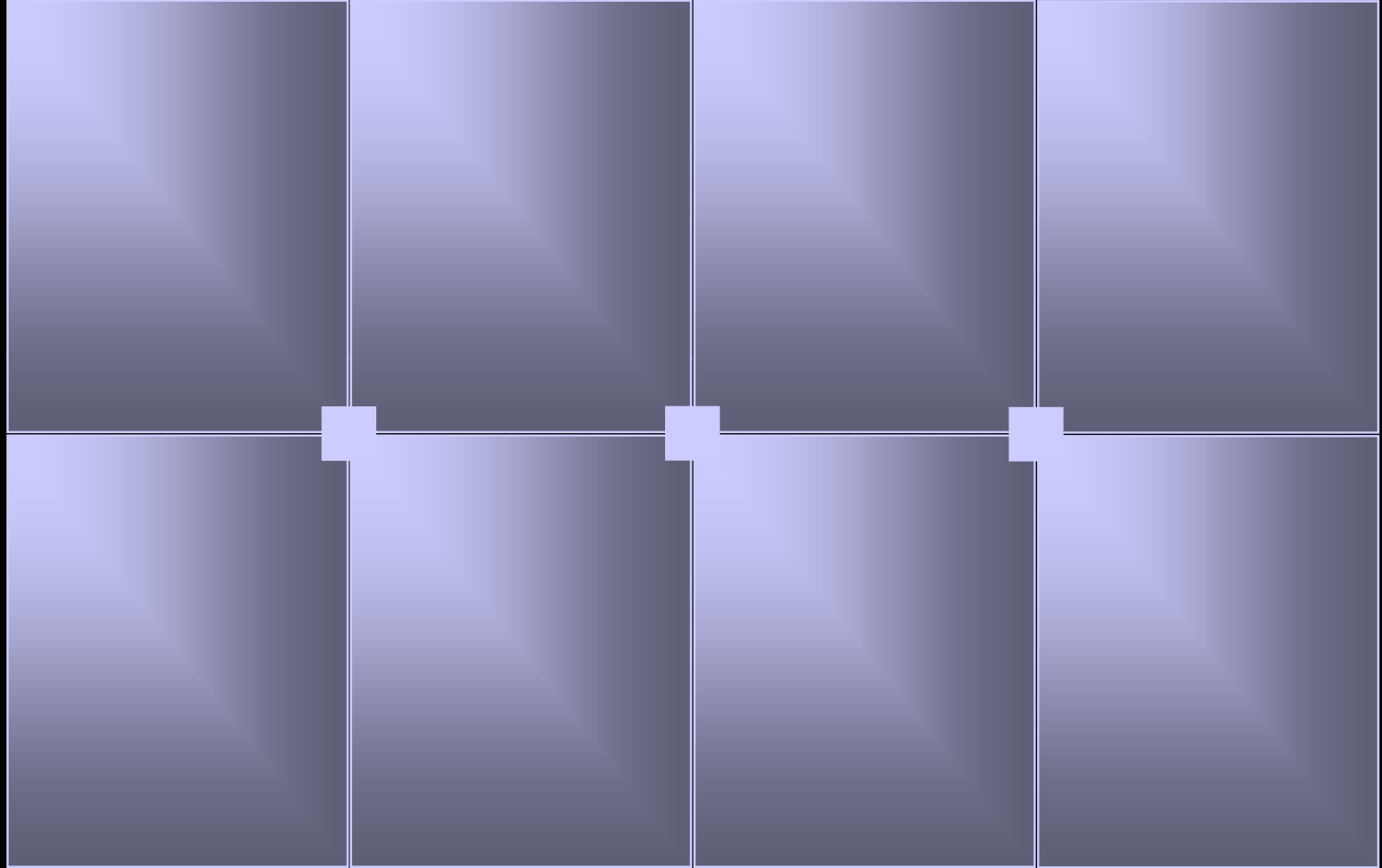


Patch Plate Structural Glass Assembly



Plan View

316 Austenitic Stainless steel patch plates
Non-compressible inert fibre spacers
M&F Countersunk bolts
Single, Double or Treble Glazing
Toughened Glass
BS 6206 Class A Impact performance
Silicon Sealant Jointing



Structural Glass Assembly

Plan View



316 Austenitic Stainless Steel
clamping plate & angles

Non-compressible inert fibre spacers

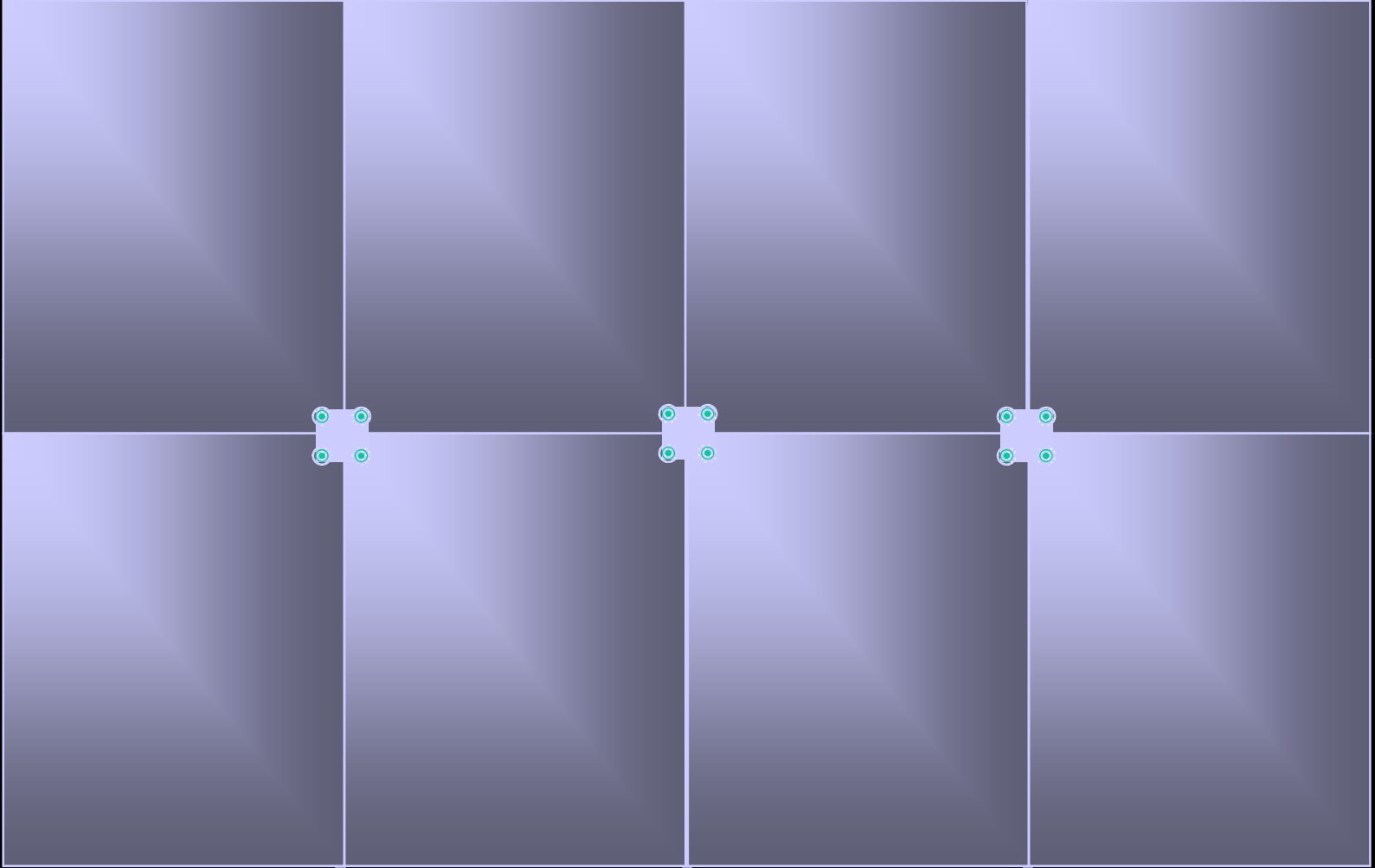
316 ASS M&F Countersunk bolts

Single, Double and Treble Glazing

Toughened Glass

BS 6206 Class A Impact performance Silicon

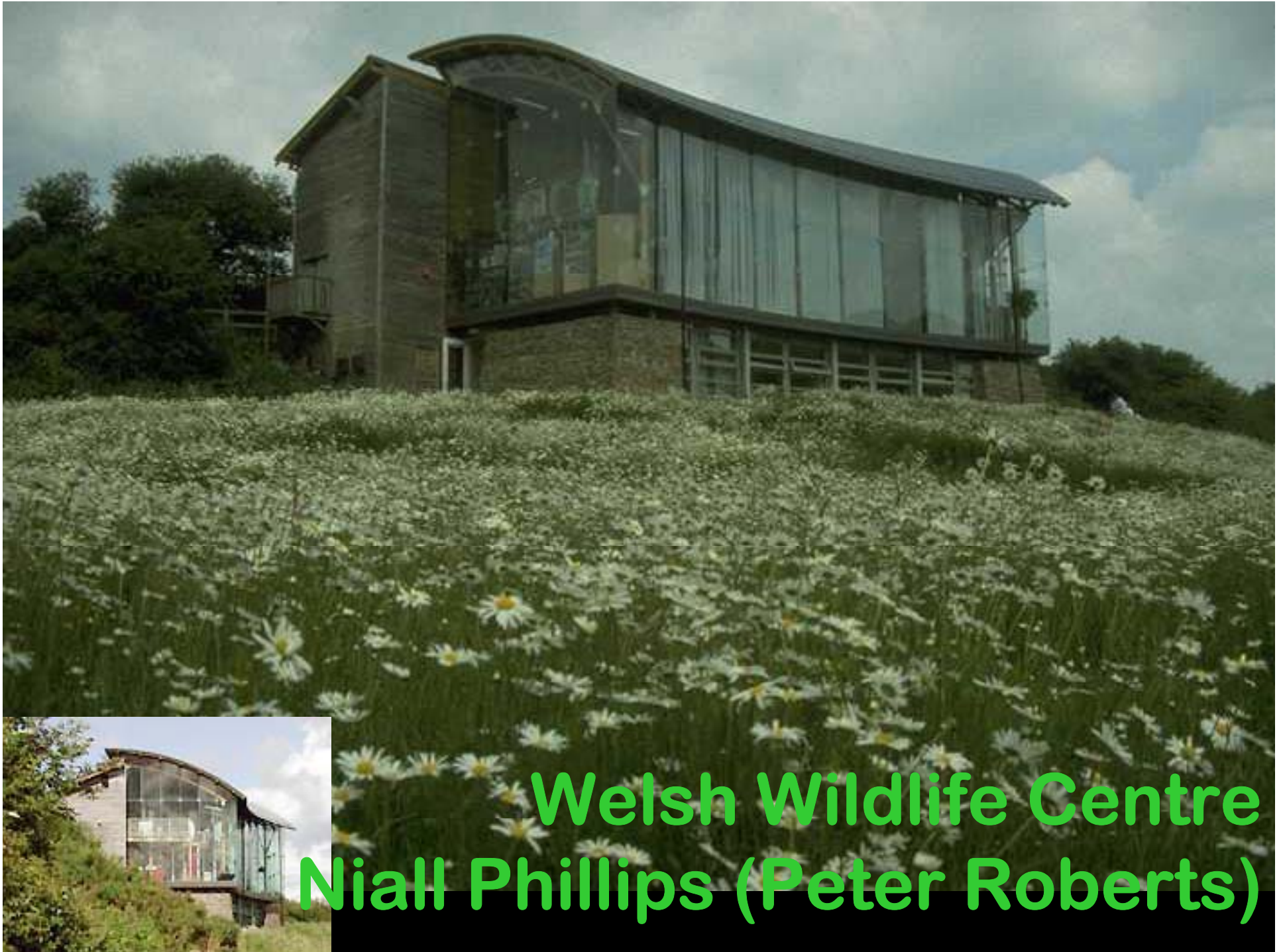
Sealant Jointing





**Methods of
Assembly and
Fastenings
to permit
deconstruction
and reuse of
components**

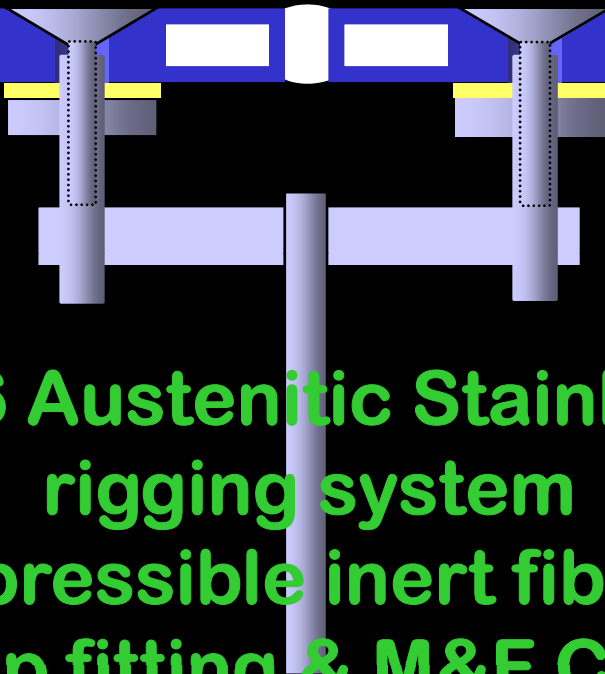
Welsh Wild Life Centre, Architect: Niall Phillips: Peter N Roberts



**Welsh Wildlife Centre
Niall Phillips (Peter Roberts)**

Structural Glass Assembly

Plan View



Marine grade 316 Austenitic Stainless steel support rigging system

Non-compressible inert fibre spacers

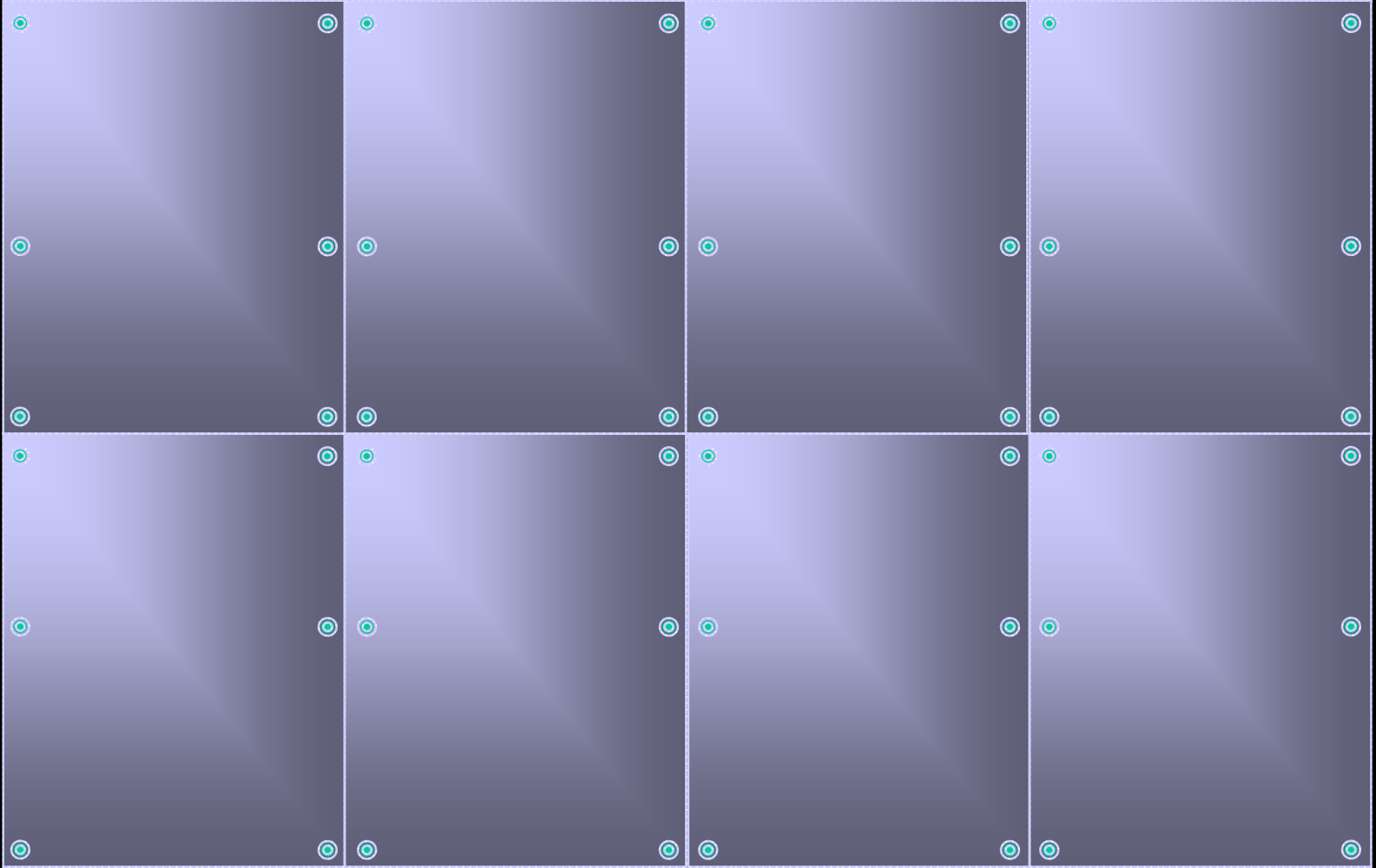
316 Spider clamp fitting & M&F Countersunk bolts

Single, Double and Treble Glazing

Toughened Glass

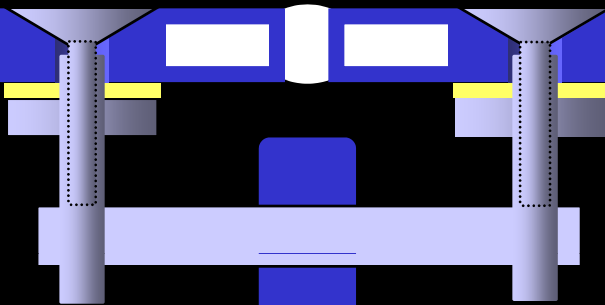
BS 6206 Class A Impact performance

Silicon Sealant Jointing

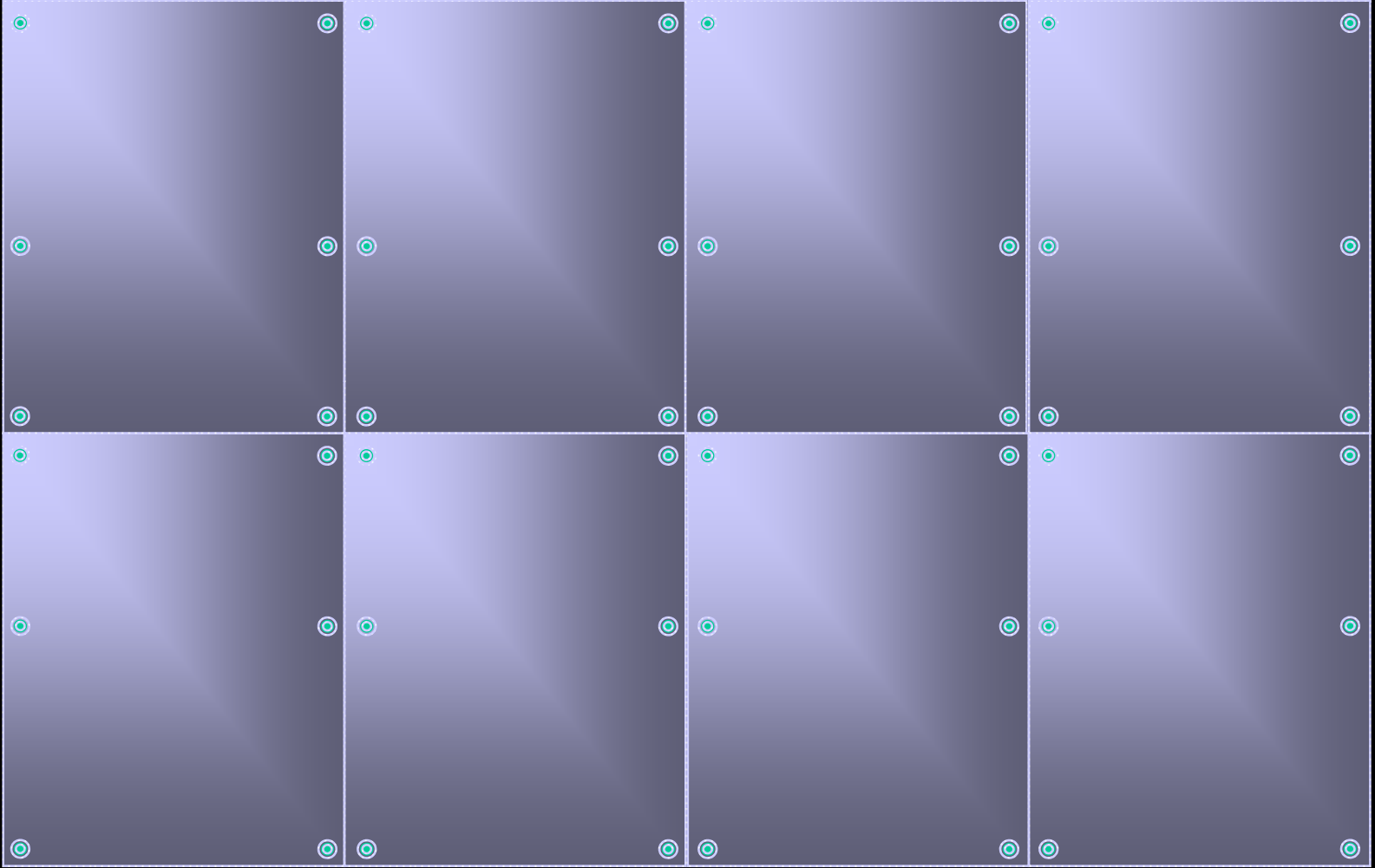


Structural Glass Fin Walling with Spider fixings

Plan View

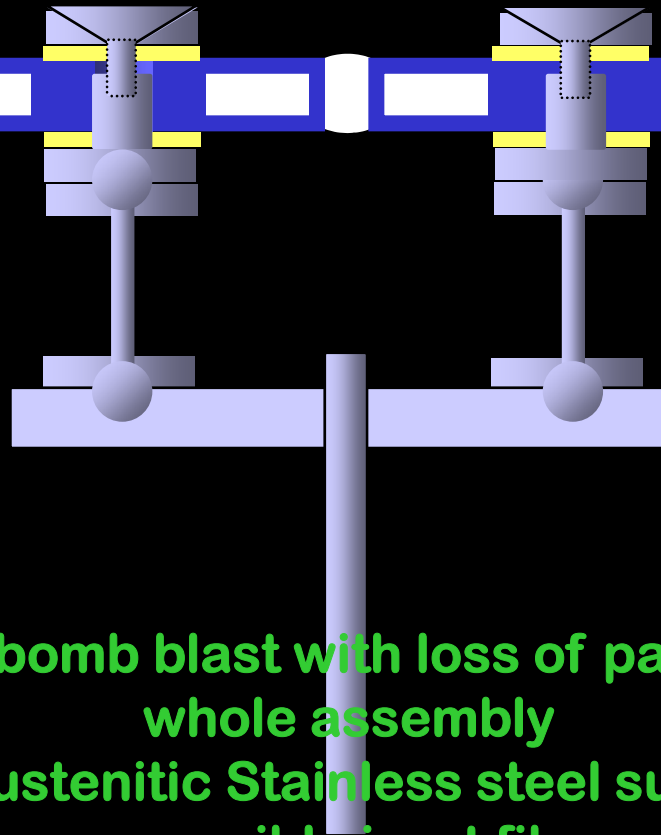


Glass wall, independent glass fin Mullions & Transoms
Marine 316 Austenitic Stainless Steel spider fixings & fastenings
Marine grade 316 Austenitic Stainless steel support rigging system
Non-compressible inert fibre spacers
316 Spider clamp fitting & M&F Countersunk bolts
Single, Double and Treble Glazing
Toughened Glass
BS 6206 Class A Impact performance
Silicon Sealant Jointing



Structural Glass Assembly

Plan View



Designed to cope in bomb blast with loss of panes and settlement of whole assembly

Marine grade 316 Austenitic Stainless steel support rigging system

Non-compressible inert fibre spacers

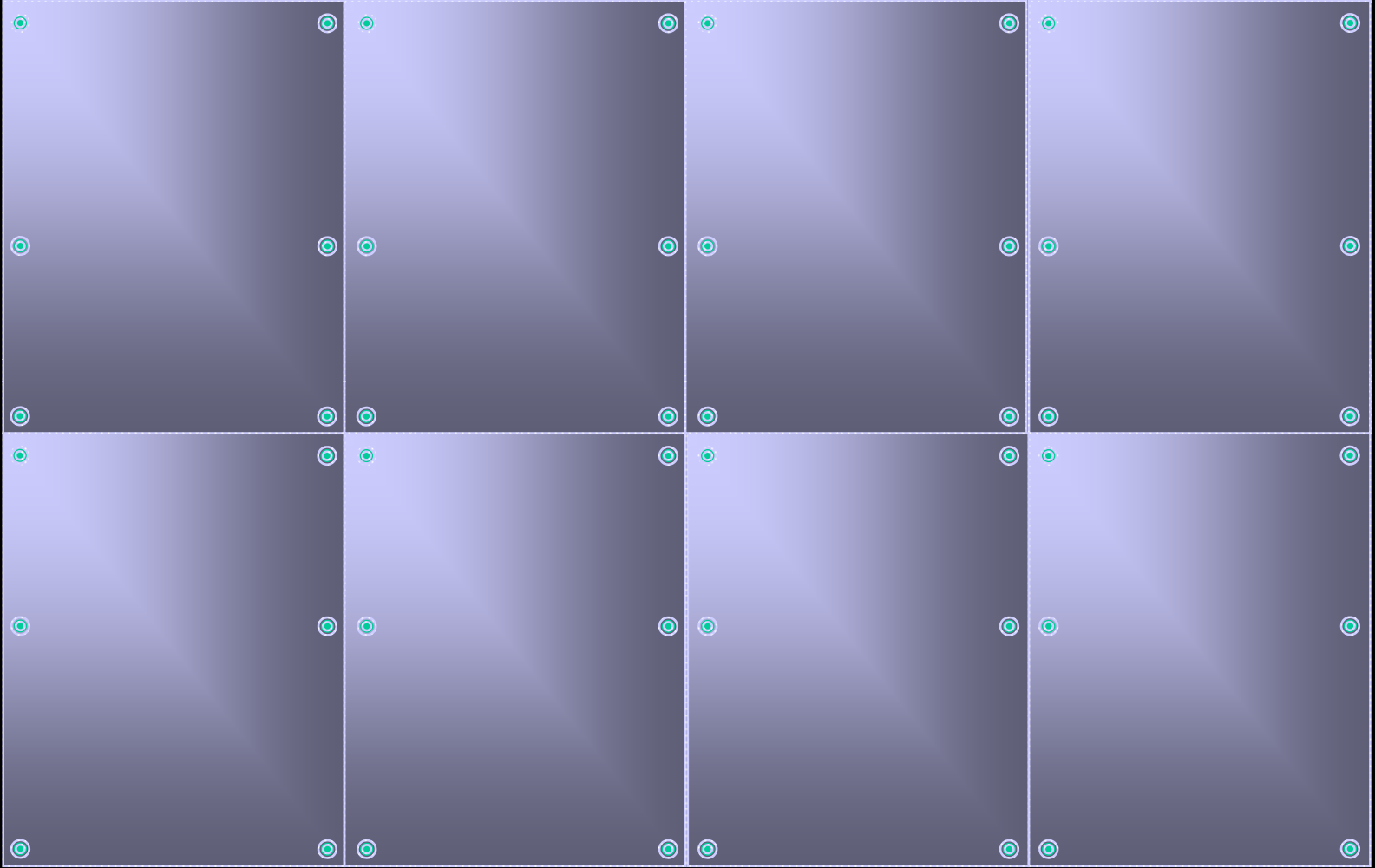
Spider clamp fitting & Universal Joint bolts

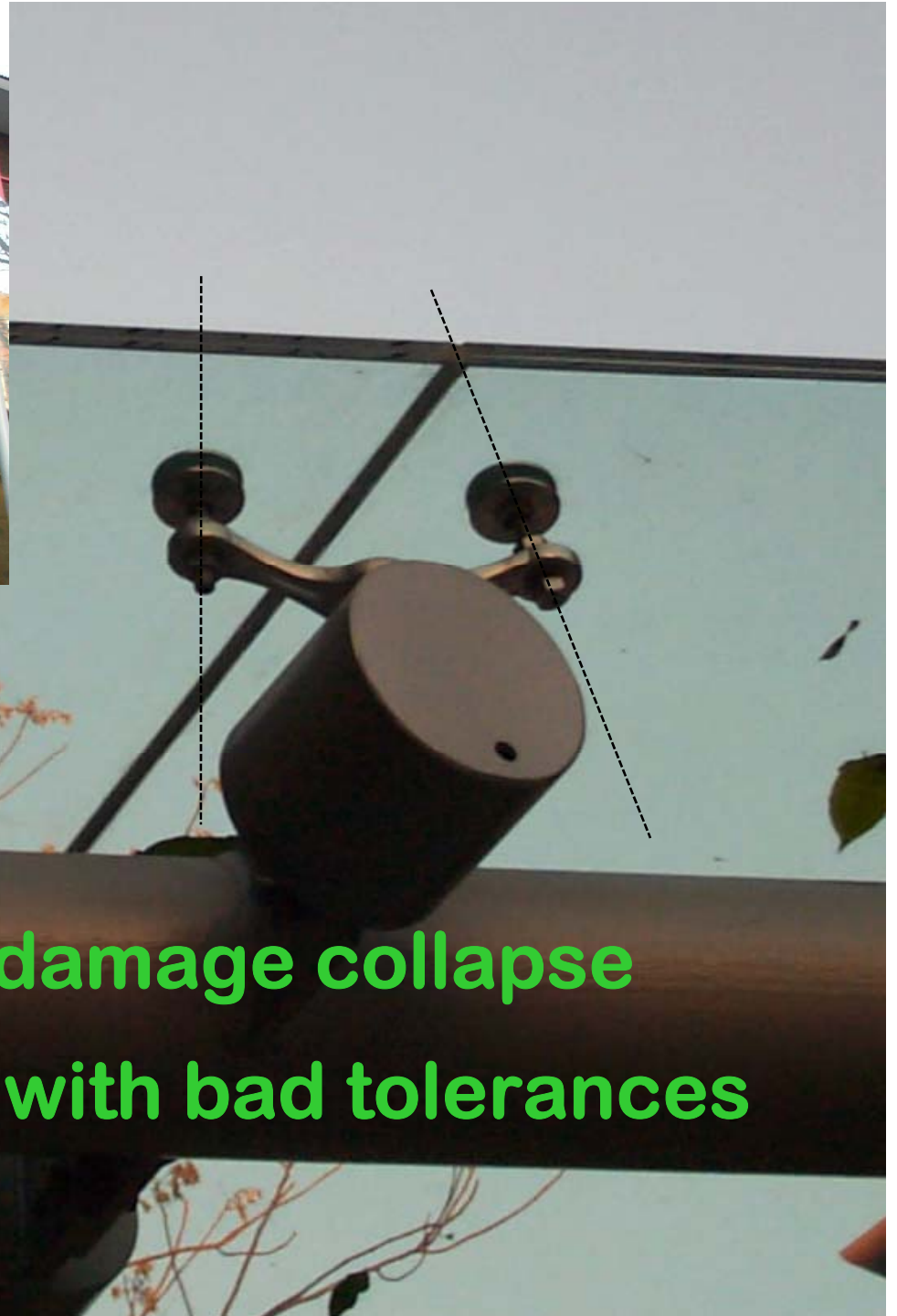
Single, Double and Treble Glazing

Toughened Glass

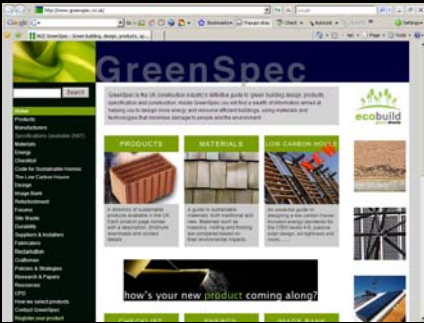
BS 6206 Class A Impact performance

Silicon Sealant Jointing





- Design for bomb damage collapse
- But used to cope with bad tolerances



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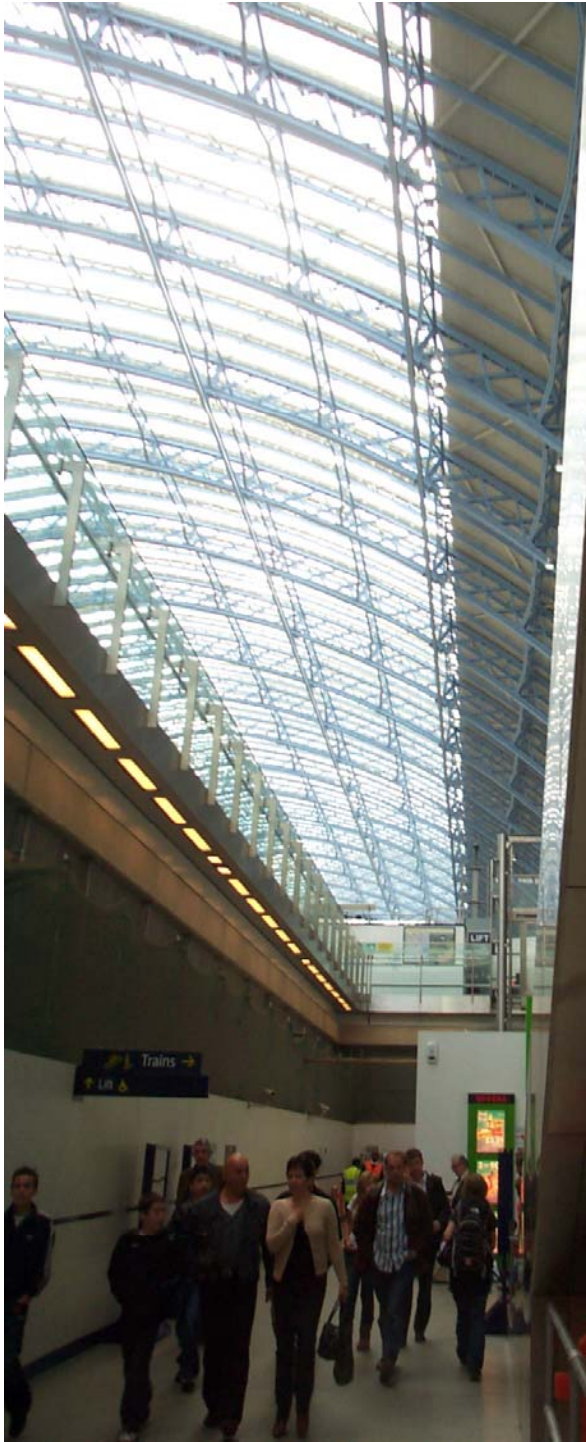
Structural Glass Balustrades

L30 Stair Balustrades Walkways



**Glass
Balustrade:
Methods of
Assembly and
Fastenings
to permit
deconstruction
and reuse of
components**

Greenwich Millennium Village and Oxford Science Park Architect: Proctor Matthews



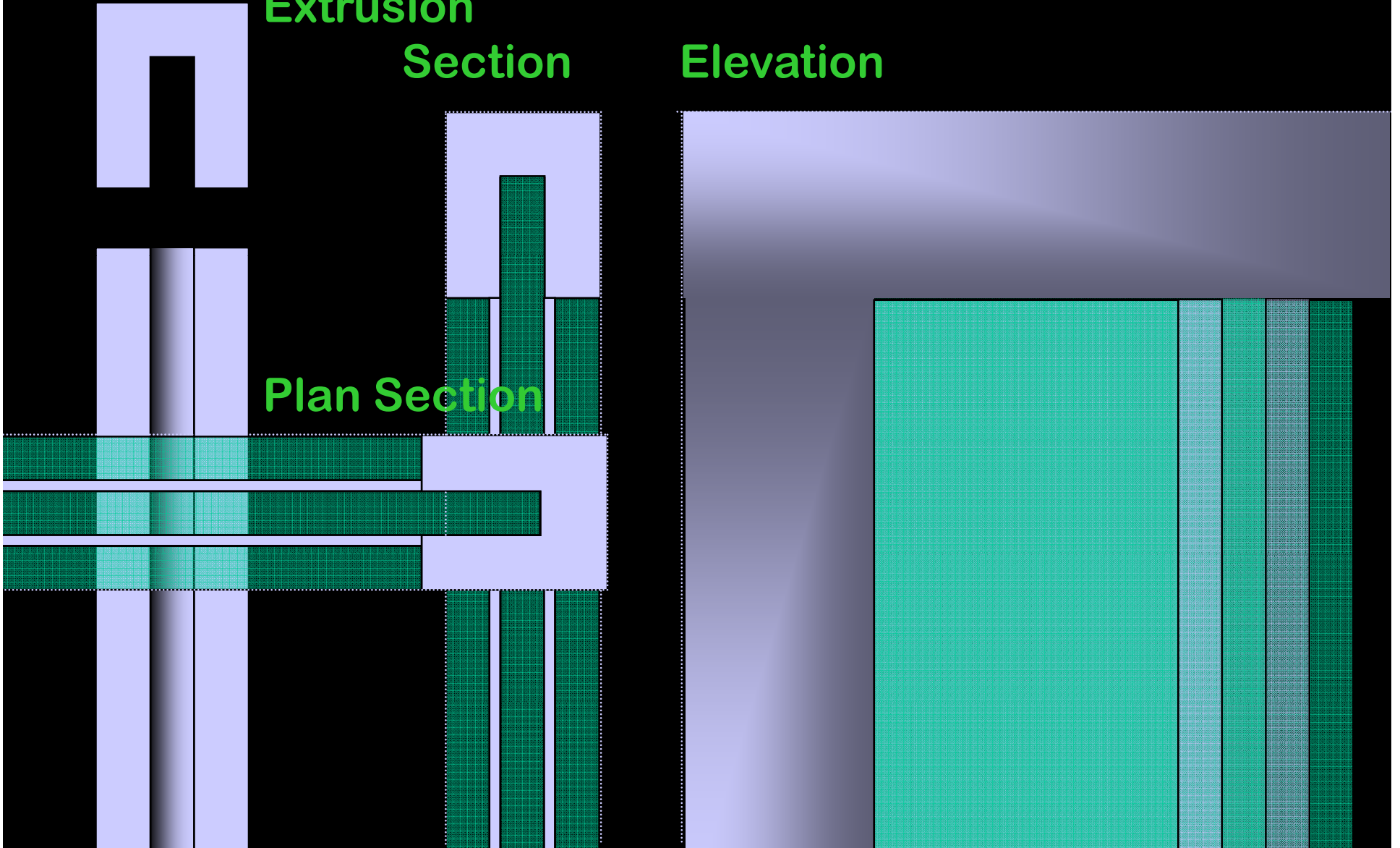
CTRL St Pancras Balustrade

Extrusion

Section

Elevation

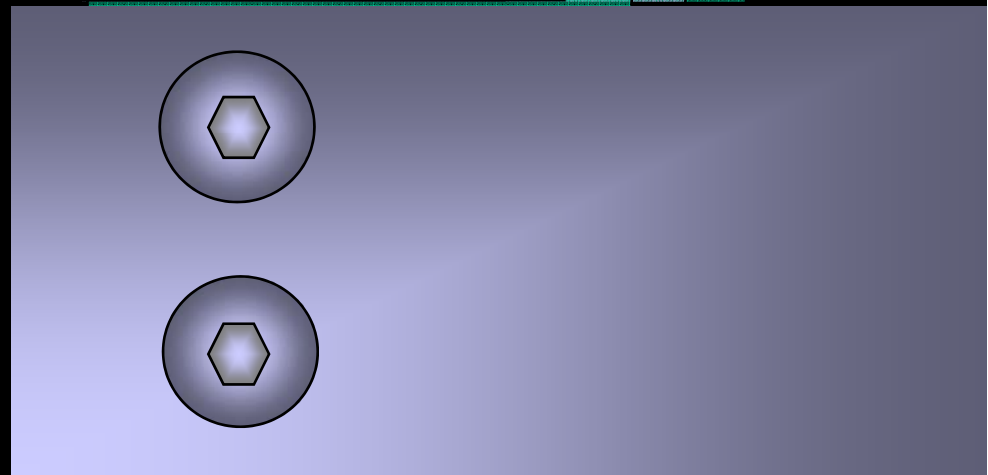
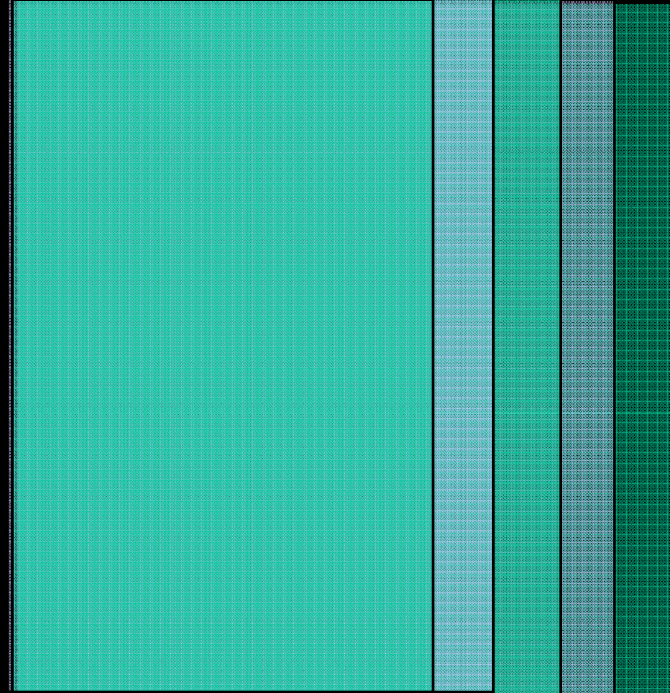
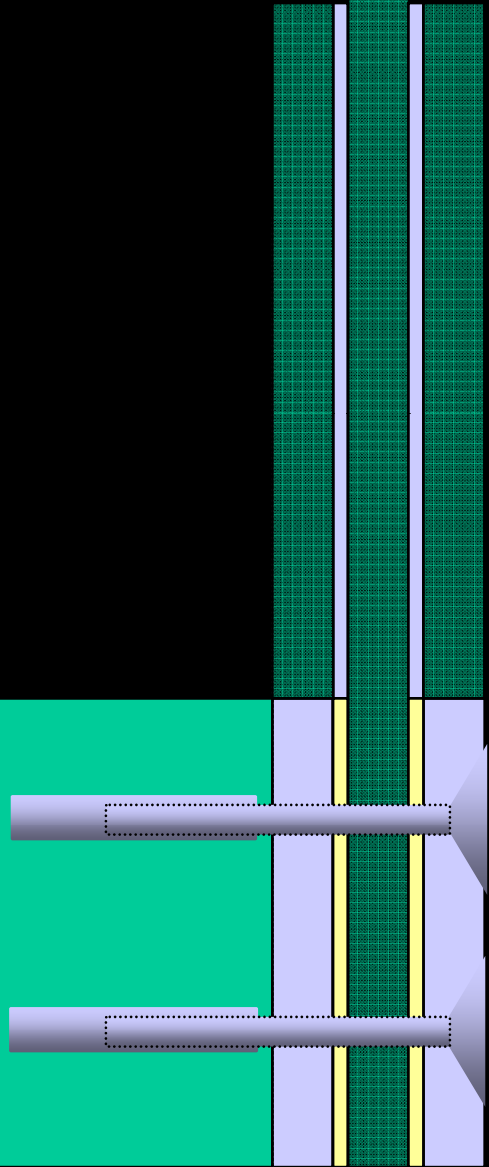
Plan Section





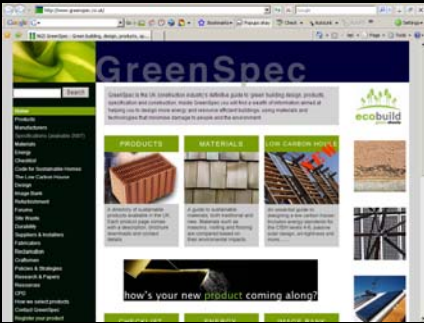
Architects: Walters & Cohen
Holmes Place Health Club Canary Wharf

CTRL St Pancras Balustrade



Section

Elevation

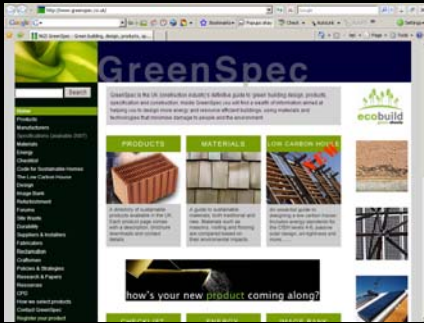


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Structural Glass Doors



Architects: Walters & Cohen
Holmes Place Health Club Canary Wharf



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Structural Glass Partitions

Structural Glass Partition



Vertical Section

316 Austenitic Stainless steel angles

Shuffle Glazing assembly

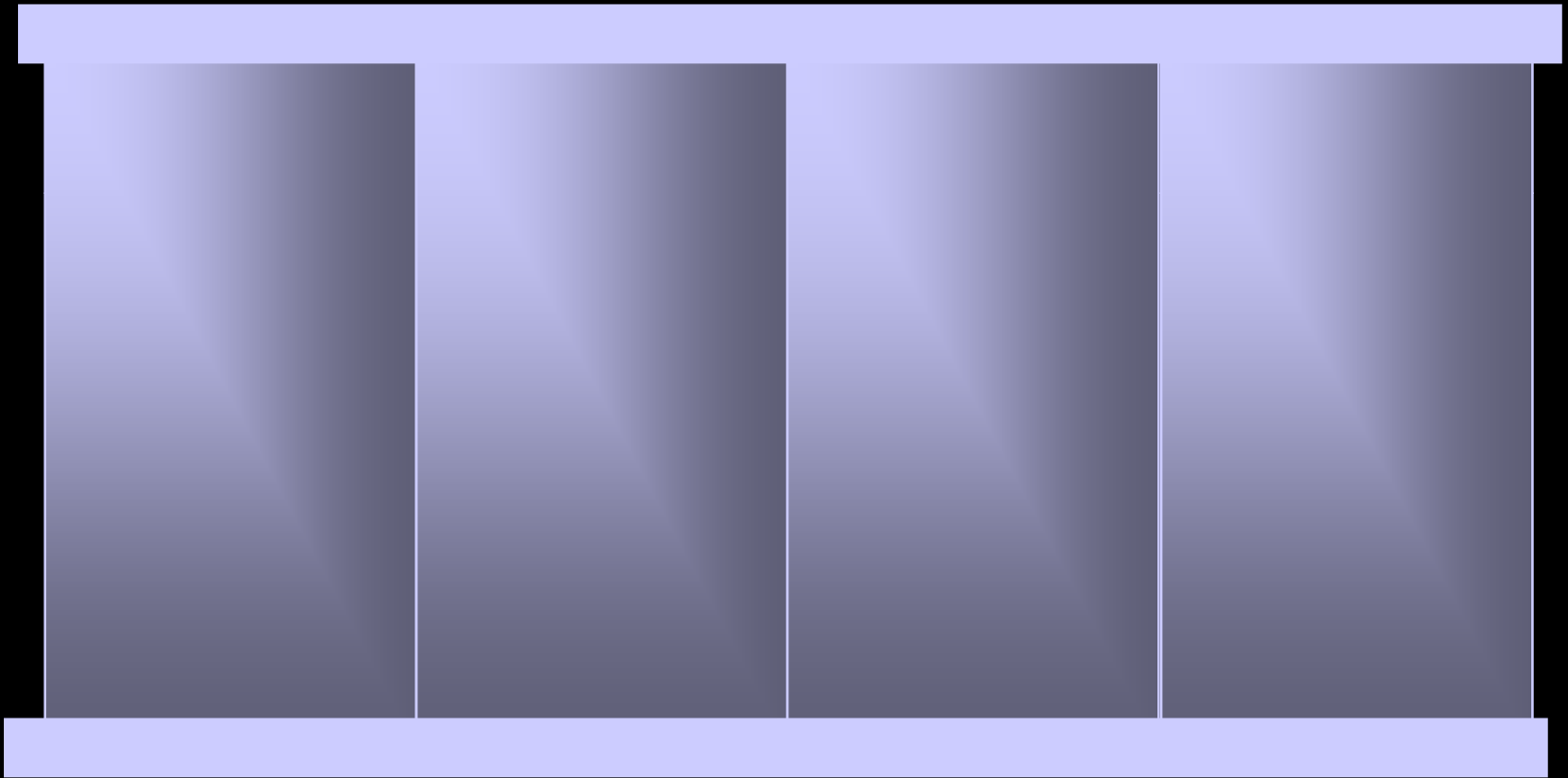
304 ASS Expanding bolts into

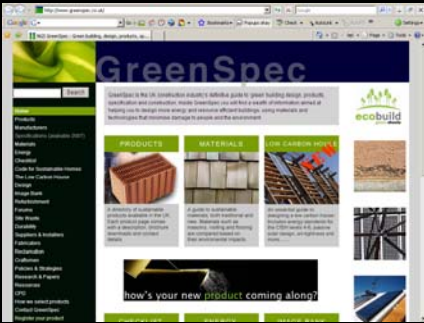
Single, Double and Treble Glazing

Toughened Glass

BS 6206 Class A Impact performance

Silicon Sealant Jointing





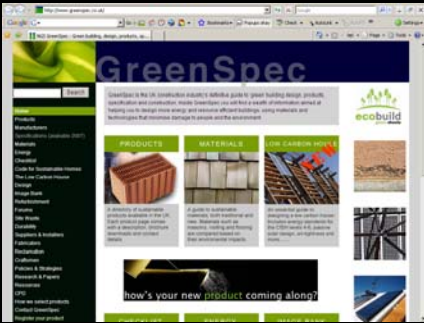
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Structural Glass Mirror Walls

- If framed support:
- Class A Impact performance
- BS 6206 & BSI Kitemarked
- If Board support
- Class B



Architects: Walters & Cohen
Holmes Place Health Club Canary Wharf



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Resource Efficiency

Waste minimisation

Glass Partitions created from glass panes

Manufactured
Glass pane

Glass Partition
same size as
pane =
No waste

Glass Partitions created from glass panes

Manufactured
Glass pane

Glass
Partition
Smaller
than pane

waste

Glass Partitions created from glass panes

Manufactured
Glass pane

Requires
second pane

Glass Partition
larger than
Manufactured
pane

And more
waste

Design for Deconstruction

- **Demountable**
- **Reclaimable Balustrade**
- **Reusable Balustrade**
- **Recyclable Stainless Steel**
- **Recyclable Glass**



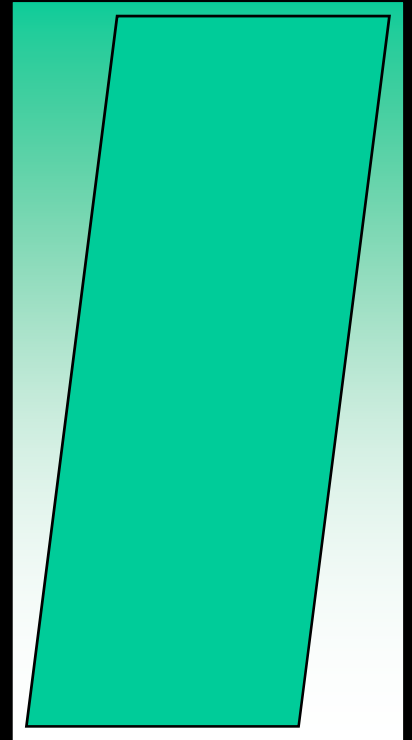
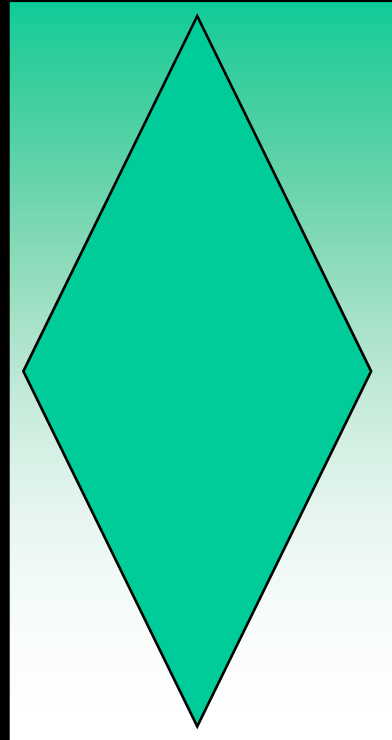
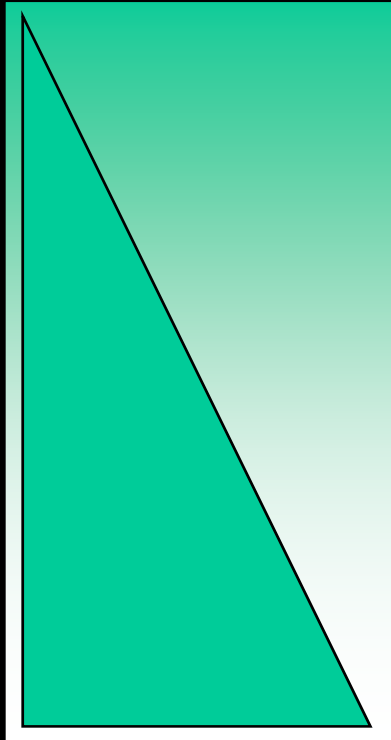
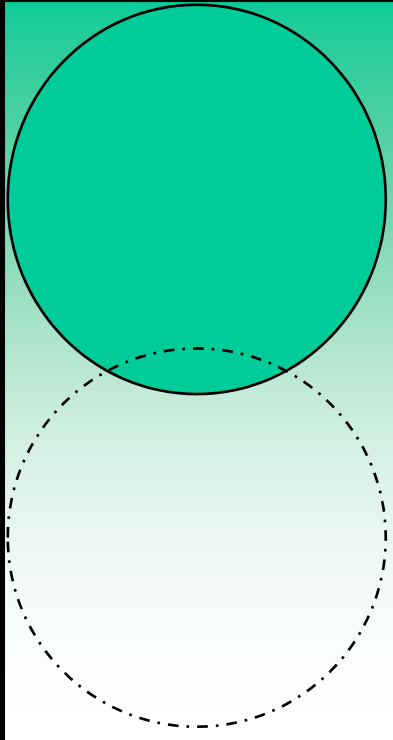
Glass Cutting: Almost Rectangular
few if any the same shape



SMM7 Standard Method of Measurement

- All shapes cut for closest rectangle
- All off-cuts are waste
- Accuracy +/-10%
- No concern about waste or site ordering from quantities
- Contractor expected to re-measure

Glass Cutting SMM



Consistent glass triangles within each level

Different triangles at almost all levels

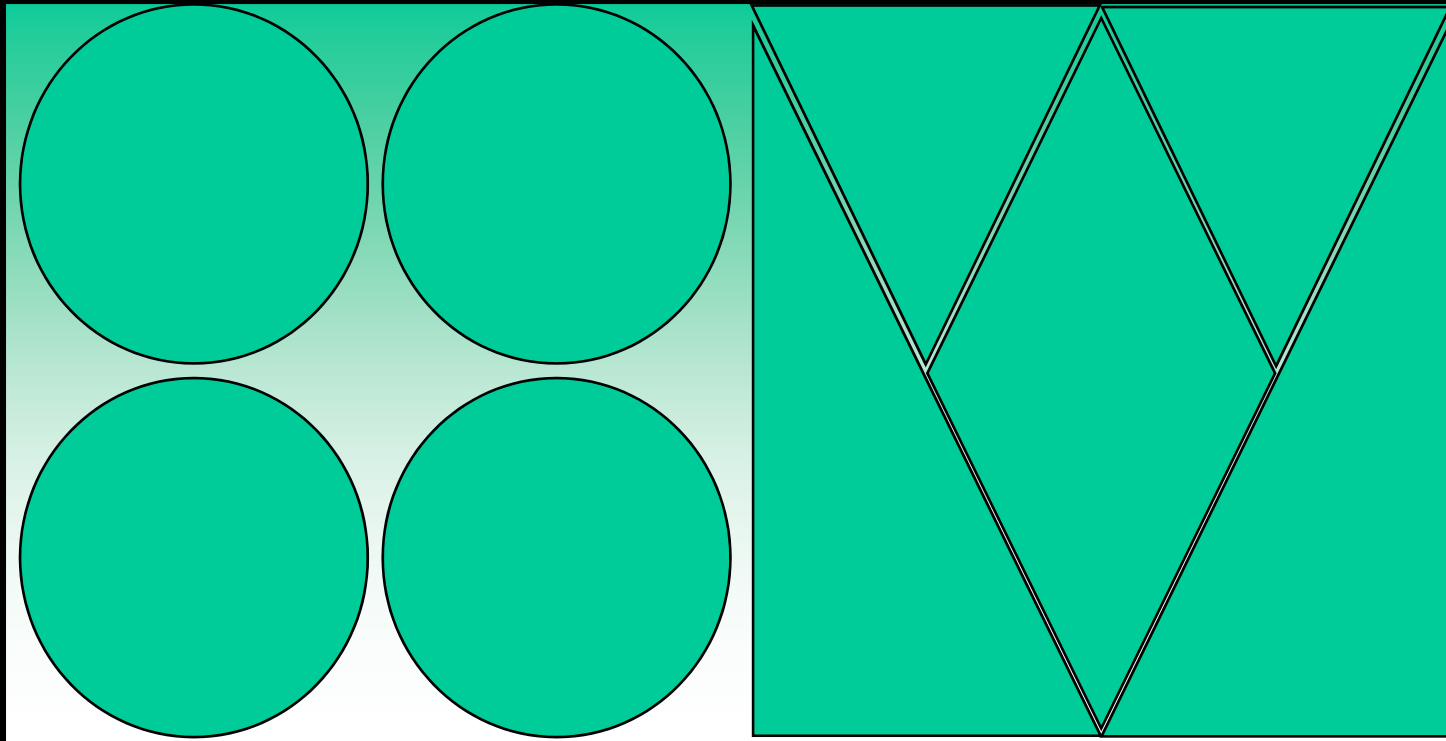
No vertical columns

Vast amounts of off cuts on the factory floor

We hope its all recycled in manufacture



Glass Cutting CAD/CAM tailoring



I Can CAD, CAD can, So I Do

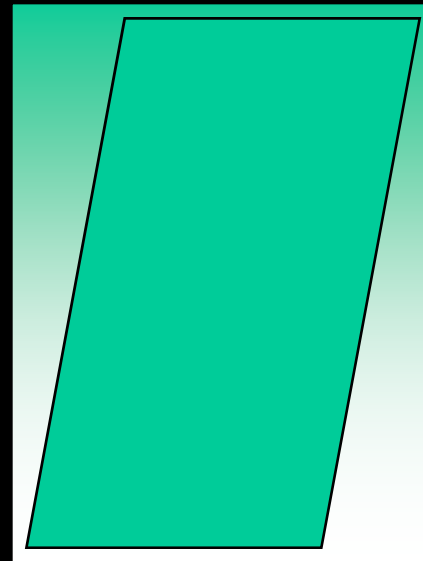
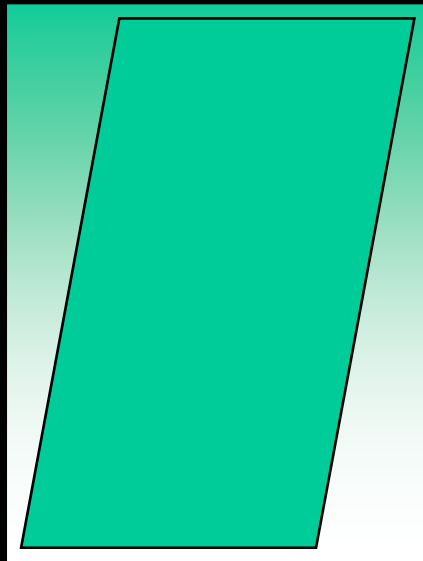




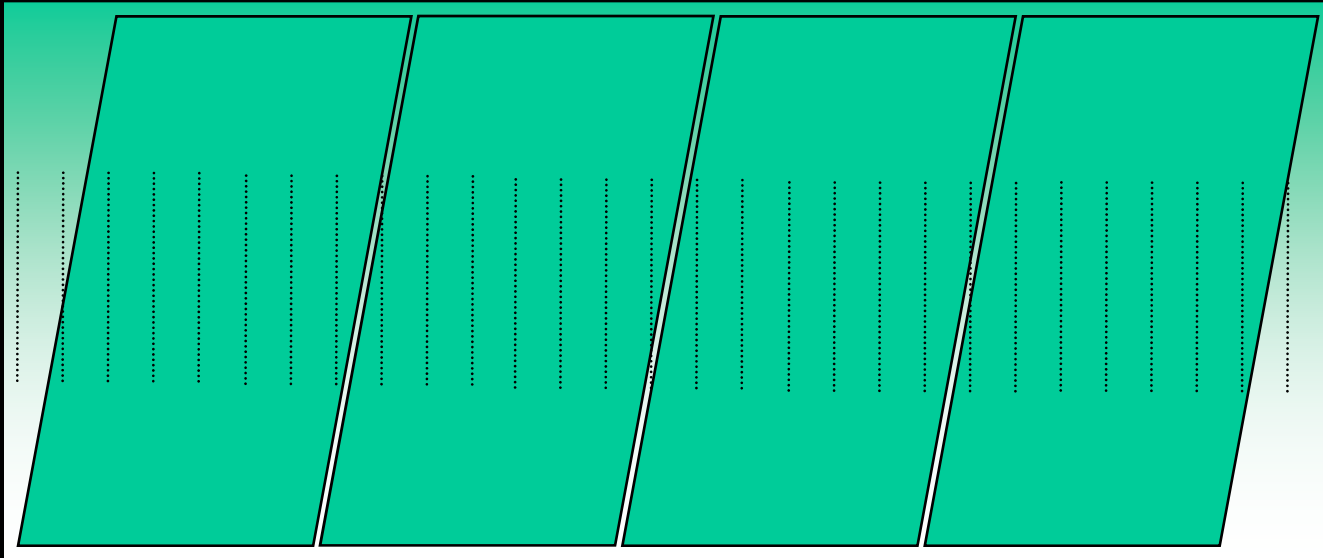
CADCAM Tailoring = Iteration

- Maximising the yield from sheets of glass
- Many pieces arranged to get more pieces from smallest glass pane
- Pieces cut from sheet
- Just like a tailor and fabric directionality is important
- Potential conflict with 'Roller Wave Pattern'
- RWP occurs as glass is rolled off zinc float and 'slumps' over supporting rollers

SMM Glass Cutting simple parallelograms



Glass Cutting CAD/CAM tailoring with simple parallelograms

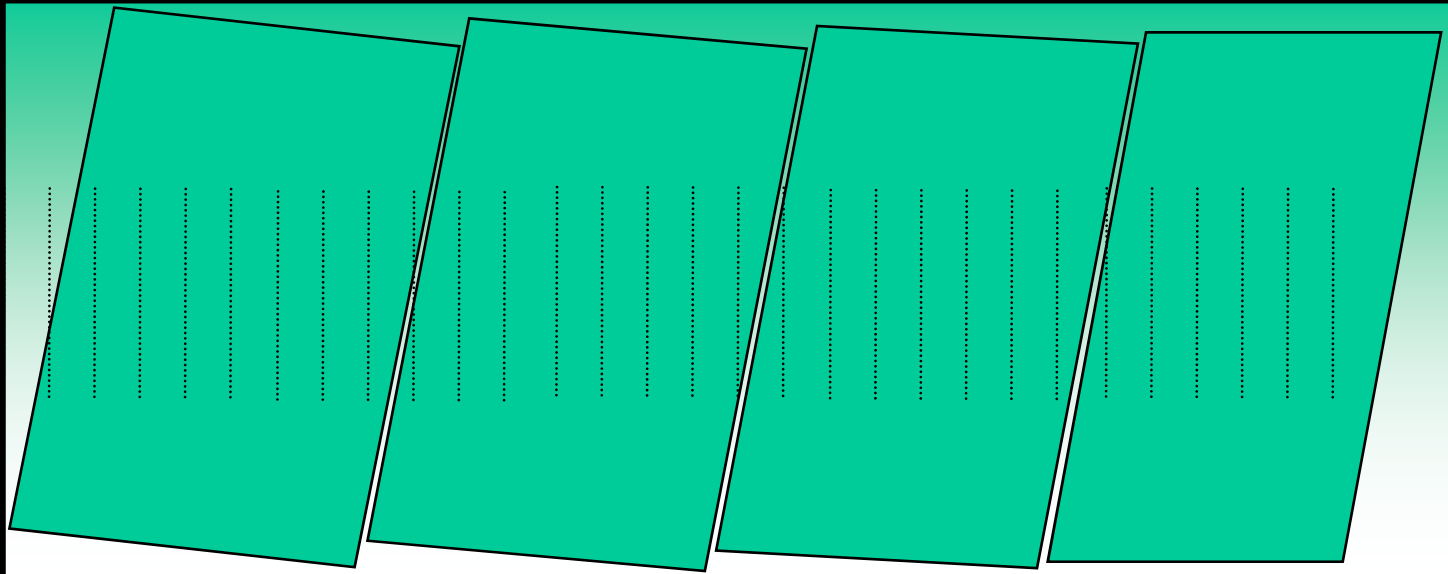


**Facetted triangles
consistent on any one level
No standard parallelograms**

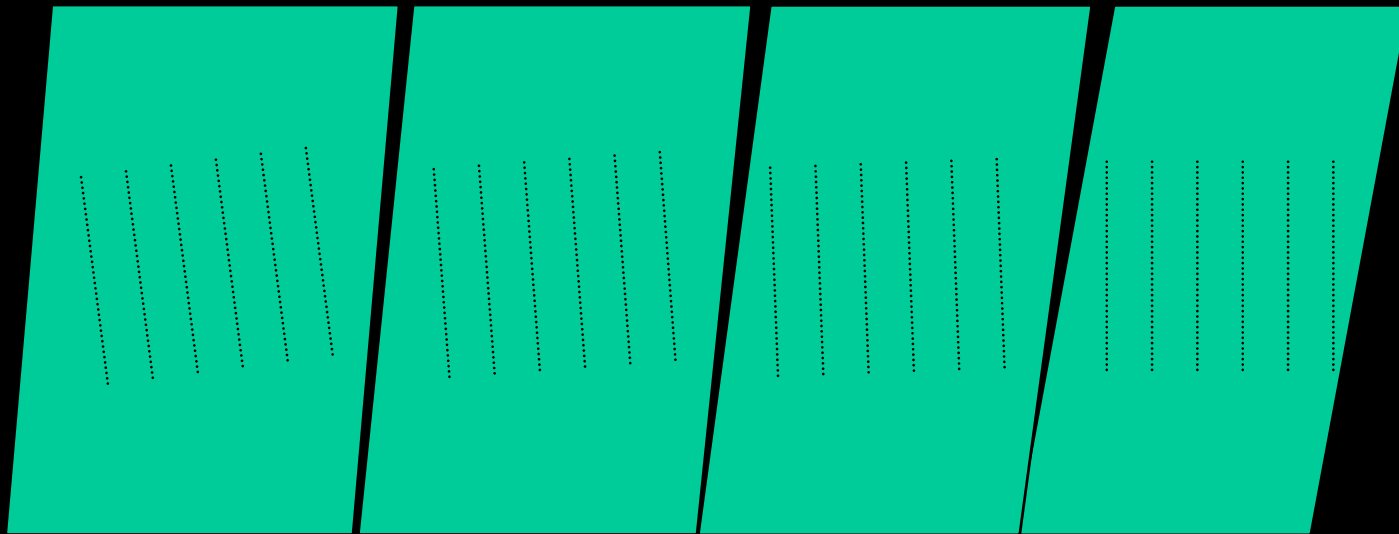


Glass Cutting CAD/CAM

No pane is the same
efficient tailoring or iteration &
efficient resource use



**Could lead to
irregular roller wave pattern
when installed**



Glass Cutting CAD/CAM

less efficient tailoring/iteration

regular installed roller wave pattern

Less efficient resource use

