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PRECAST-POSTTENSION
CONCRETE SPECIALISTS

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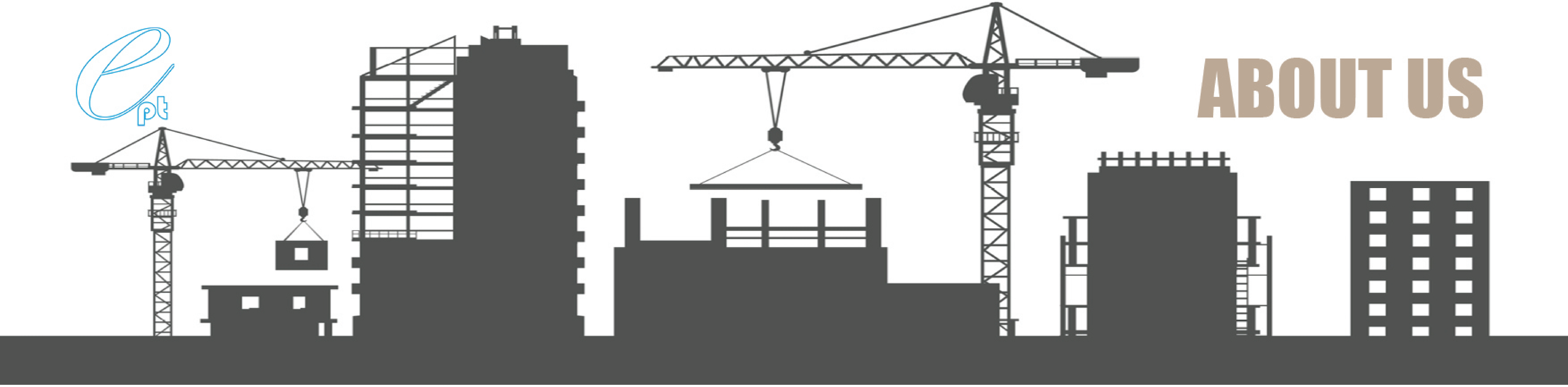
"Your construction partners"

Design and Build Projects
Precast concrete construction
Tilt up concrete construction
Posttension concrete
Modular Concrete Construction

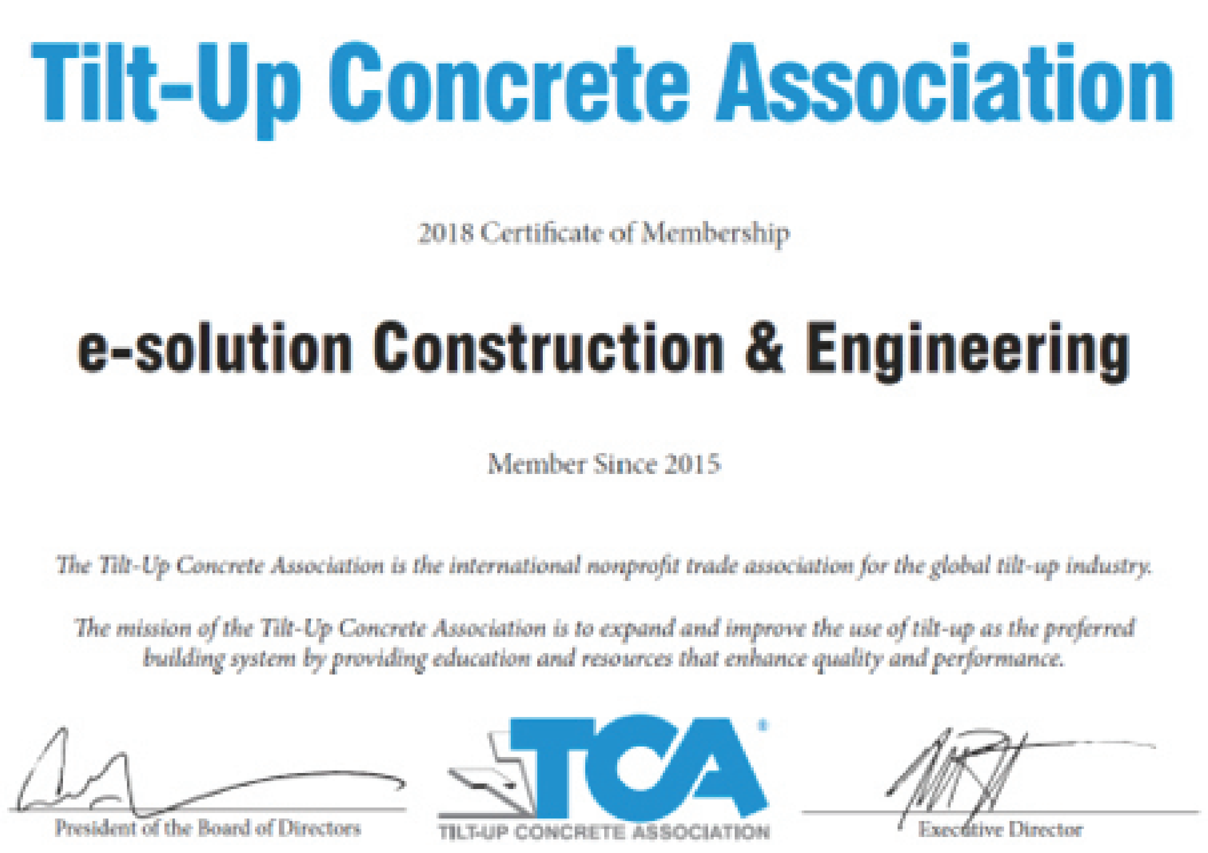
ABOUT US



e-solution Construction & Engineering with its headquarter in USA-Ohio-Toledo and main branches in Saudi Arabia and Cairo-Egypt Since 2004, we have been providing our clients with reliable solutions to their most complex construction challenges. Our strength lies in traditional construction methods and for our creative, fresh approach to cutting-edge technologies and delivery systems.

Our success is driven by our innovative solution to complex projects that met the client demands and within project budget. Our clients are turning to us for our ability to implement project management techniques and to serve as a reliable provider of knowledge-driven solutions for construction projects.

The people who make up the team at e-solution Construction & Engineering Company embody our values of strength, performance and passion. Our employees have strong connections to these ideas, which have contributed significantly to the progressive growth, success and leadership of our company. They have helped us develop the solutions, systems and project methods required to bring innovation, quality and value to the projects we deliver for our clients.



Tilt-Up Concrete Association

2018 Certificate of Membership

e-solution Construction & Engineering

Member Since 2015

The Tilt-Up Concrete Association is the international nonprofit trade association for the global tilt-up industry.

The mission of the Tilt-Up Concrete Association is to expand and improve the use of tilt-up as the preferred building system by providing education and resources that enhance quality and performance.

President of the Board of Directors — TCA TILT-UP CONCRETE ASSOCIATION — Executive Director

MEMBERSHIPS

TCA Tilt-Up Concrete Association

PTI Posttension Concrete institute

ACI American concrete institute

POST-TENSIONING INSTITUTE

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Certificate of Membership

This certifies that

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is a member through

December 31, 2018

Executive Director — President

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MISSION

To be the leading organization by providing through innovation the most innovative solutions to the construction field, our pledge is to establish lasting relationships with our customers by exceeding their expectations and gaining their trust through exceptional performance by our construction team.

VISION

To become the preferred supplier for engineering services and integrated solutions to our valued customers in the diversified market segments.

CORE VALUES

STRENGTH

We are a solid partner for our customers and all stakeholders based on the integrity and competence of our people, our decades of experience, our track record for delivering results and the backing of a global industry leader.

PERFORMANCE

We demand excellence, deliver on our promises and continuously search for new and better ways to provide the best solutions for our customers and our stakeholders.

PASSION

We care about and are personally committed to everything we do, our people safety and development, our customers and their success.

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What is Posttension?

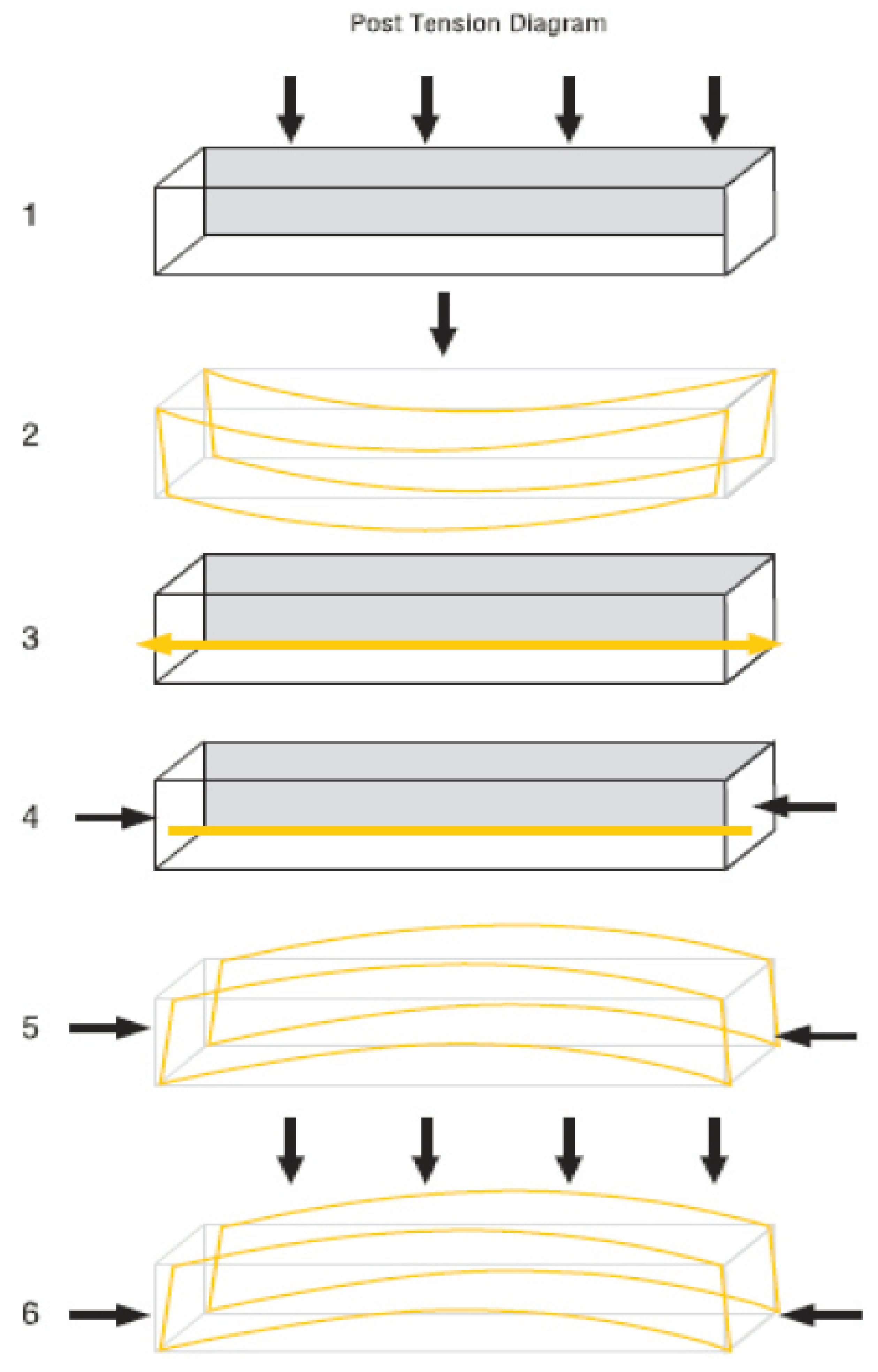
The principle is easily observed when loading together several books by pressing them laterally, Under such pressure the whole row gains enough stiffness and strength to ensure its integrity.

In concrete structures, this is achieved by placing high tensile steel tendons (cables) in the element before casting, when the concrete reaches the desired strength; the tendons are pulled by special hydraulic jacks and held in tensioning using specially designed anchorages fixed at each end of the tendon.
This provides compressions at the edges of the structural member that increase the capacity of the concrete resisting tension stresses.

If tendons are appropriately curved to certain profile they will exert in addition to the compression at the perimeter a beneficial upwards set of forces that will counteracts applied loads, relieving the structure from a portion of gravity effects Post tensioning is a process of pre-stressing with reinforced concrete or equivalent material that possesses high strength steel strands or bars commonly referred to as tendons. Concrete is strong in compression but weak in tension so to counter this, compression force is introduced to the concrete after casting, lending it strength to withstand slab weight and heavy loads. This also helps in minimal deflection and cracking under heavy load.

Post-tensioning process could be applied on any building, residential, commercial of office buildings. It could also be applied to parking structures slabs-on-ground, bridges, sports stadia, rock and soil anchors or water tanks.

Post tensioning even allows construction at sites where it is not feasible to build owing to site and architectural deficiencies. Post-tensioning as a process requires specialized knowledge and well trained staff.



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BONDED SYSTEM

Bonded Post-Tensioning Slab System consists of fully encapsulated, bonded multi-strand (two to five strands) tendons contained in flat ducts filled with a high-performance cementitious grout that bonds the strands to the surrounding concrete.

Intermediate anchorages provide continuous encapsulation at construction joints. Tendons are protected by both duct and grout.

Bonded post-tensioned concrete is the descriptive term for a method of applying compression after pouring concrete and the curing process (in situ),The concrete is cast around plastic, steel or aluminum curved duct, to follow the area where otherwise tension would occur in the concrete element.

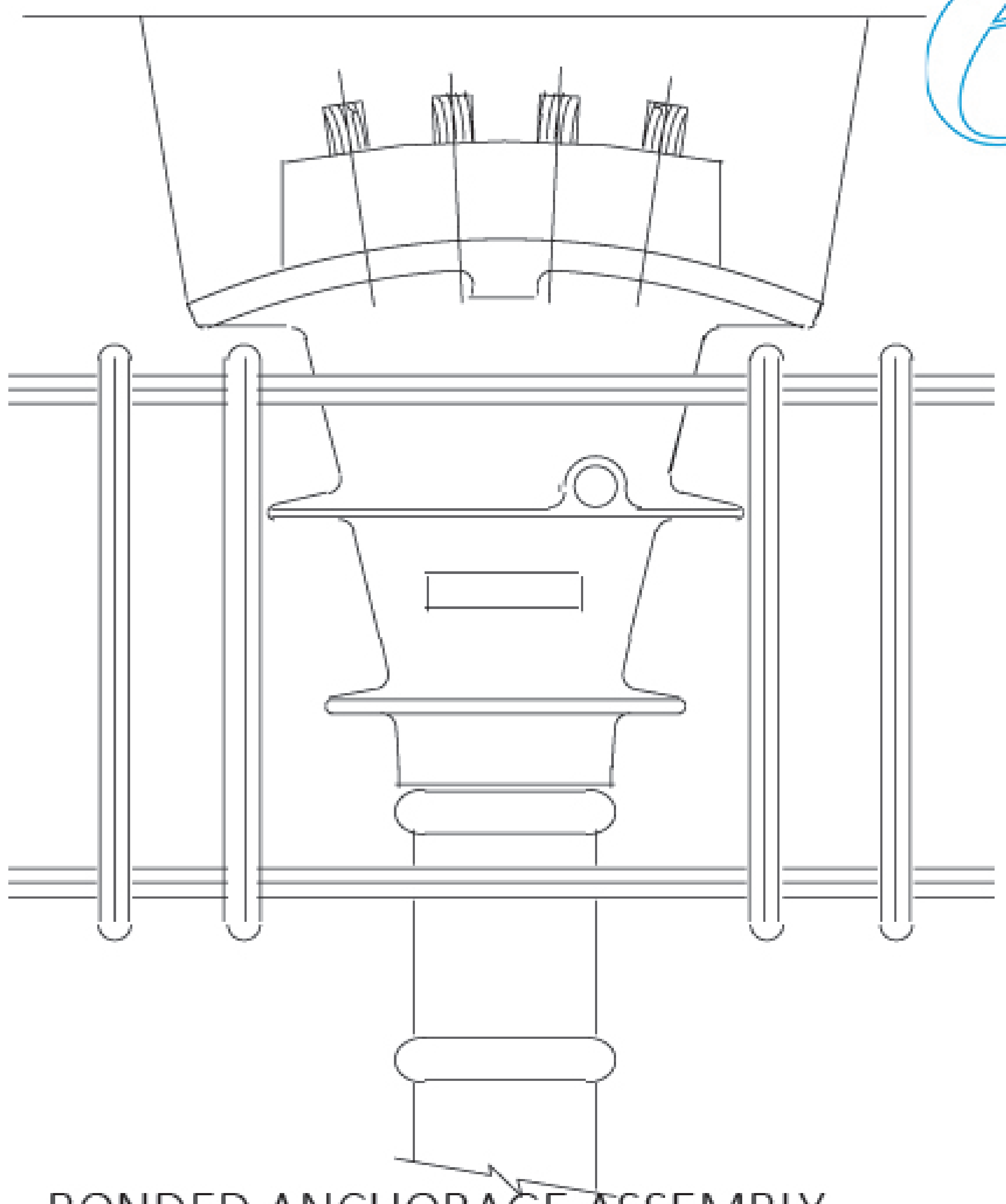
A set of tendons are fished through the duct and the concrete is poured. Once the concrete has hardened, the tendons are tensioned by hydraulic jacks.

When the tendons have stretched sufficiently, according to the design specifications they are wedged in position and maintain tension after the jacks are removed, transferring pressure to the concrete. The duct is then grouted to protect the tendons from corrosion.

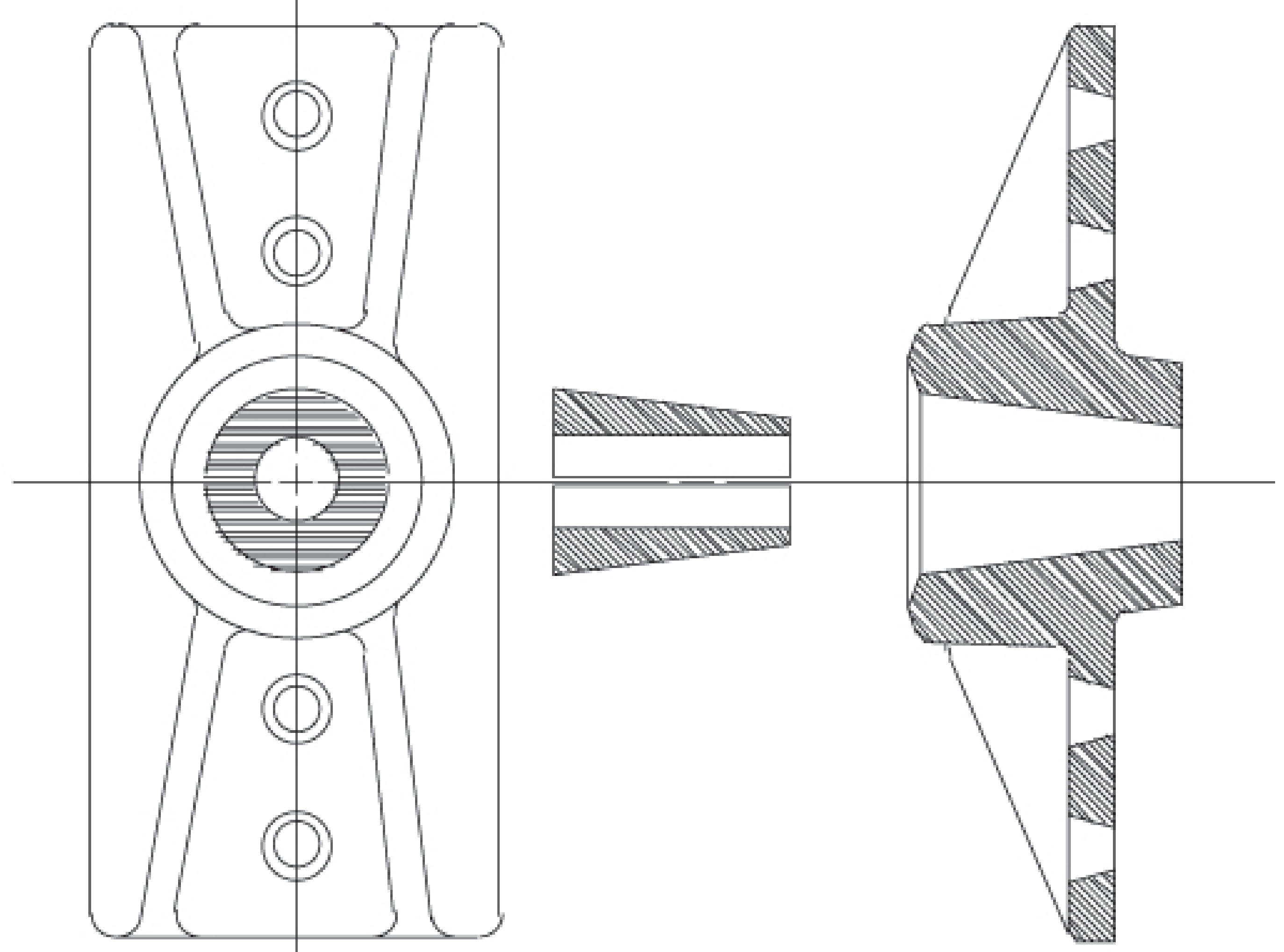
UN-BONDED SYSTEM

Adaptable to a variety of structures, un-bonded mono-strand post-tensioning can be easily, rapidly and economically installed.
Use 0.5” and 0.6” diameter strands coated with a layer of specially formulated grease with an outer layer of seamless plastic extruded in one continuous operation to provide protection against corrosion. Each tendon is precisely coiled, cut, labeled, color-coded and delivered to the construction site.

A wide variety of anchorage systems are available to meet design specifications. Encapsulated un-bonded mono-strand posttensioning systems are used in areas that are subject to corrosive conditions. Strands are protected at the anchorages using greased plastic sleeves and grease-filled end caps.
Additionally, anchorage components are fully encapsulated in a high density polyethylene plastic covering and an optional encapsulated intermediate coupler anchorage system can be used to protect the strand at construction joints.
The transfer of tension to the concrete is achieved by the steel cable acting against steel anchors in the perimeter of the slab.
The main disadvantage over bonded posttensioning is the fact that a cable can de-stressitself and burst out of the slab if damaged (such as during repair on the slab)



BONDED ANCHORAGE ASSEMBLY



UNBONDED ANCHORAGE HEAD

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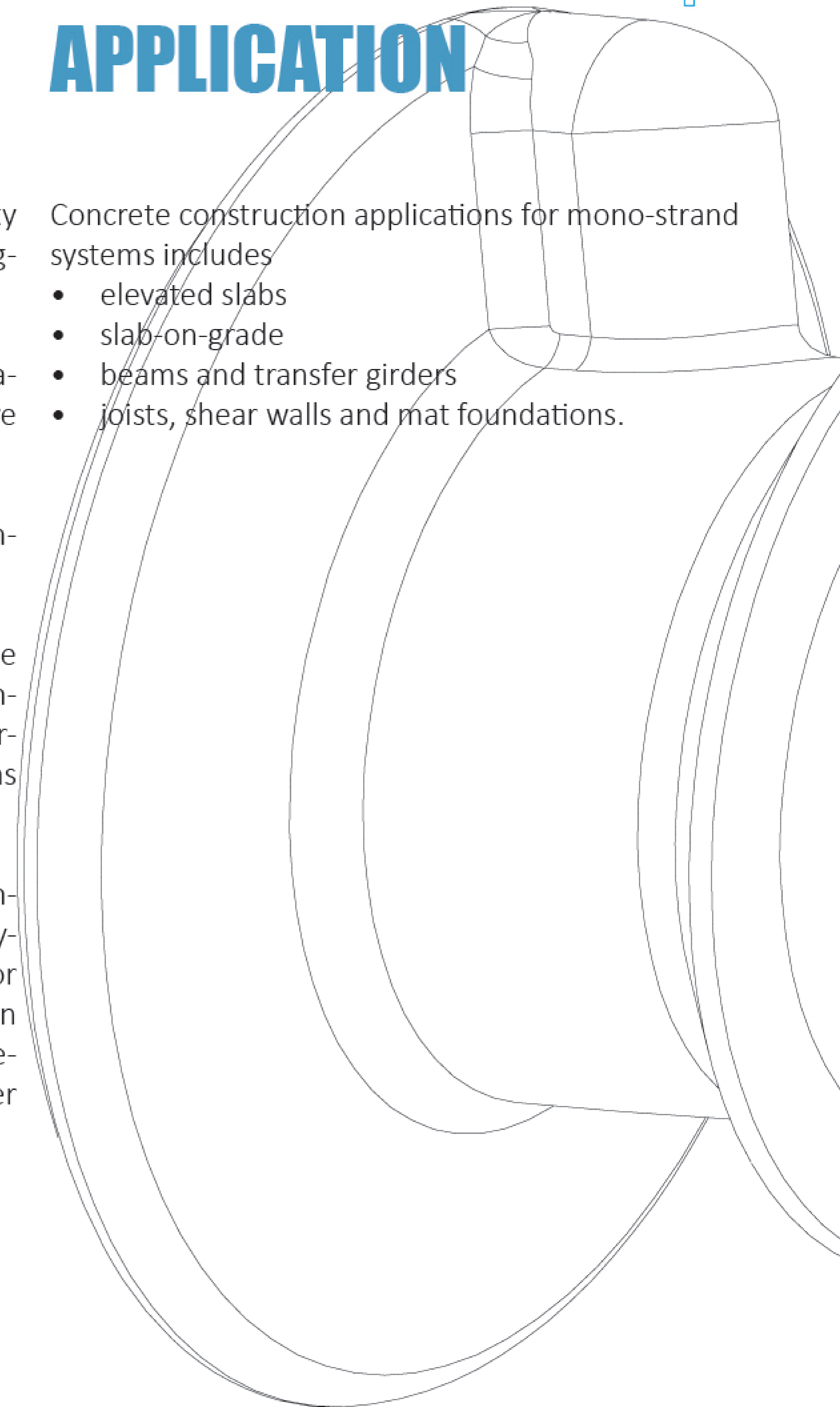
ADVANTAGES

- Significant reduction in the amount of concrete and reinforcing steel required.
- Thinner structural members as compared to non-prestressed concrete, resulting in lower overall building heights and reduced foundation loads.
- Aesthetically pleasing structures that harness the benefits of cast-in-place structures with curved geometries, longer cantilevers and slender members with large spaces between supports.
- Superior structural integrity as compared to precast concrete construction because of continuous framing and tendon continuity.
- Monolithic connections between slabs, beams, and columns that can eliminate troublesome joints between elements that require maintenance.
- Profiled tendons that result in balanced gravity loads (typically a portion of dead load only), significantly reducing total deflection.
- Better crack control, which results from permanent compressive forces applied to the structure during prestressing.
- Reduction in overall building mass, which is important in zones of high seismicity.
- As compared to steel, non-prestressed concrete and precast construction offer faster floor construction cycles, lower floor weight, lower floor-to-floor height, larger spans between columns and reduced foundations.
- The high early-strength of post-tensioned concrete allows for faster floor construction cycles and the use of standard design details for post-tensioned elements, minimum congestion of prestressed and non-prestressed reinforcement, and earlier stripping of formwork after tendon stressing.

APPLICATION

Concrete construction applications for mono-strand systems includes

- elevated slabs
- slab-on-grade
- beams and transfer girders
- joists, shear walls and mat foundations.



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STRUCTURAL SYSTEMS

The three most common floor systems used for building structures such as offices, shopping centers and car parks are the flat plate, flat slab, ribbed slab and banded slab.

Post-tensioning is not limited to simple flat slabs and the range of structural types which can be economically stressed is almost limitless. Some of the most common floor systems are presented below along with recommended concrete sizes and span to depth ratios.

FLAT SLAB

This system is commonly used for high rise residential construction where the span is usually 7 to 8 meters. The most attractive feature of this floor system is its flush soffit which requires simple formwork and greatly simplifies construction. The depth of a flat plate is often dictated by shear requirements.

FLAT PLATE

A widely used system today for many reasons flat soffit, simple formwork and ease of construction, as well as flexibility for locating services. The economical span range over a flat plate is increase by the addition of drop panels.
The drop panels increase the flexural stiffness of the floor as well as improving its punching shear strength.

This system provides the thinnest floors and can lead to height reductions and substantial savings in facade costs.

BANDED SLAB

This system is used for structures where spans in one direction are predominant. It is also a very common system due to minimum material costs as well as relatively simple formwork. In most circumstances the width of the band beam is chosen to suit the standard sizes of the formwork.

The sides of the band can be either square, or tapered for a more attractive result. The band beam has a relatively wide, shallow cross section which reduces the overall depth of the floor while permitting longer spans.

This concrete section simplifies the formwork and- permits services to easily pass under the beams. The post-tensioned tendons are not interwoven leading to fast installation and decreased cycle time.

The band beam system has another advantage that is not widely appreciated. In most circumstances depending on the actual geometry of the cross section the beam can be considered as a two way slab for fire rating and shear design. This enables considerable economies to be achieved in both post tensioning and reinforcement quantities.

RIBBED SLAB

For longer spans the weight of a solid slab adds to both the frame and foundation costs. By using a ribbed slab, which reduces the self-weight, large spans can be economically constructed.

The one-way spanning ribbed slab provides a very adaptable structure able to accommodate openings. As with beam and slab floors, the ribs can either span between band beams formed within the depth of the slab or between more traditional down stand beams.

For long two-way spans, waffle slabs give a very material-efficient option capable of supporting high loads.

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DESIGN

DESIGN DEVELOPMENT

- Determine loading
- Determine floor system
- Calculate cross-sectional properties
- Determine material properties
- Select un-bonded or bonded tendon systems
- Determine cover requirements for reinforcement
- Determine fire rating and wearing surface requirements
- Determine maximum tendon drape profile
- Set target load balancing
- Set average compression limits
- Select allowable stresses
- Determine load combinations

FINAL DESIGN

- Calculate post-tensioning force using load balancing and verify minimum precompression level
- Calculate member moments due to gravity loads
- Compute secondary moments
- Calculate moment redistribution
- Check service stresses
- Calculate minimum non-pre-stressed reinforcement (Un-bonded system) &Calculate temperature and shrinkage reinforcement
- Check ultimate strength and supplement with Non-pre-stressed reinforcement, if required
- Check punching shear
- Check deflection
- Construction documents
- Prepare framing plans showing posttensioning layout, final effective forces, and profiles
- Show non-pre-stressed reinforcement layout on the framing plans
- Provide details at openings, reentrant corners.

PLANNING FOR OPENING

There is no doubt that during the lifetime of a structure the requirements of a tenant may alter with time or the tenant may change several times.

Each new tenant will have his own requirements for mechanical, hydraulic and electrical services, as well as loading arrangements and general layout.

Therefore, for a building to remain readily, it must have the flexibility to accommodate openings for stairs, services or lifts, and the possibility for changes in loading patterns.

Holes through pre-stressed slabs can be accommodated easily if they are identified at the design stage. Small holes (less than 300 mm x 300 mm) can generally be positioned anywhere on the slab, between tendons, without any special requirements.

Larger holes are accommodated by locally displacing the continuous tendons around the hole. It is good detailing practice to overlap any stopped off (or 'dead-ended') tendons towards the corners of the holes in order to eliminate any cracking at the corners.
In ribbed slabs, holes can be readily incorporated between ribs or, for larger holes, by amending rib spacing or by stopping-off ribs and transferring forces to the adjoining ribs

CUTTING TENDONS

BONDED TENDONS

Bonded tendons are located within oval shaped galvanized ducts which are injected with cement grout following the posttensioning procedure. Consequently when such a tendon is severed, the free end will become de-tensioned but after a short transmission length the full tendon force will be effective. This distance is in the order of 800 to 1000 mm.

Present quality assurance methods and supervision ensure that the tendons have been adequately grouted after the application of pre-stress.

If a penetration is required that will need the termination of a bonded tendon, then the procedure follows that for a fully reinforced structure.

Cutting a bonded post-tensioned tendon is, structurally, the same as cutting through conventional reinforcement. The tendon, however, needs to be `terminated' in order to give full corrosion protection (as does conventional reinforcement).

Tendons are easy to cut using a disc cutter.In fact, cutting tendons requires less effort than for a fully reinforced slab due to the relative amount of reinforcing material to be cut.

UN-BONDED TENDONS

These tendons come individually greased and plastic coated and are therefore permanently de-bonded from the slab.

When unbonded tendons are severed, the prestressing force will be lost for the full length of the tendon. When contemplating the cutting of an unbonded tendon it is therefore necessary to consider the aspects as noted below.

The strand is packed with grease which prevents an explosive release of energy when the tendon is severed. Even so a gradual release of force is recommended.

This can be achieved by using two open throat jacks back to back. After cutting the strand the force can be gently released by closing the jacks.

Adjacent spans may require temporary propping depending upon the number of tendons severed at one time. It is rare for a slab to carry its full design load. A design check based on actual loading at the time of the modification may show props to be unnecessary.

When the edge of the slab is re-concreted new anchors are cast in to enable the remaining lengths of tendon to be Prestressed, thus restoring full structural integrity. The above operations are not difficult but will require the expertise of a post-tensioning sub-contractor.

METHOD

Installation

- Mark out anchor locations on edge boards showing heights of slot and bolt hole required to be cut and drilled. Record any discrepancies between the shop drawing .and actual deck dimensions, and report to supervisor, or project engineer.
- Where top stressing· pockets are required, position and tie in at correct height.
- Layout ducting from anchor and tape joins firmly.
- Set-up strand in a Site and record coil identification no.
- Measure length of tendon, pull out strand and cut to length. (Allow enough length for stressing)
- Push strands into duct, checking shop drawing for number in each tendon and that the length is sufficient.

For single end stressed tendons:

- Onion head each strand at the non-anchor end.
- Position dead-end and chair up to correct height
- Fit bar chairs of reinforcing bar supports under full length of tendon at locations as per the shop drawing .and tie in place, checking for minimum cover to all surfaces..
- Staple feet of bar chairs to formwork soffit where applicable.
-
- Fit grout tube to all anchors and dead ends. If tendon length exceeds 20m internal an intermediate grout vent shall be fitted at the central high point, this is a precaution against the grout thickening over an extended length and can be used as a grout inlet if required.
- Seal duct to anchor connection, and termination of duct at dead-ends to prevent concrete and slurry ingress.
- Ensure that the strands and tendons for aliment and completion as per approved shop drawings
- Make any adjustments or rectification's requested by the Consulting Engineer after inspection.

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Stressing

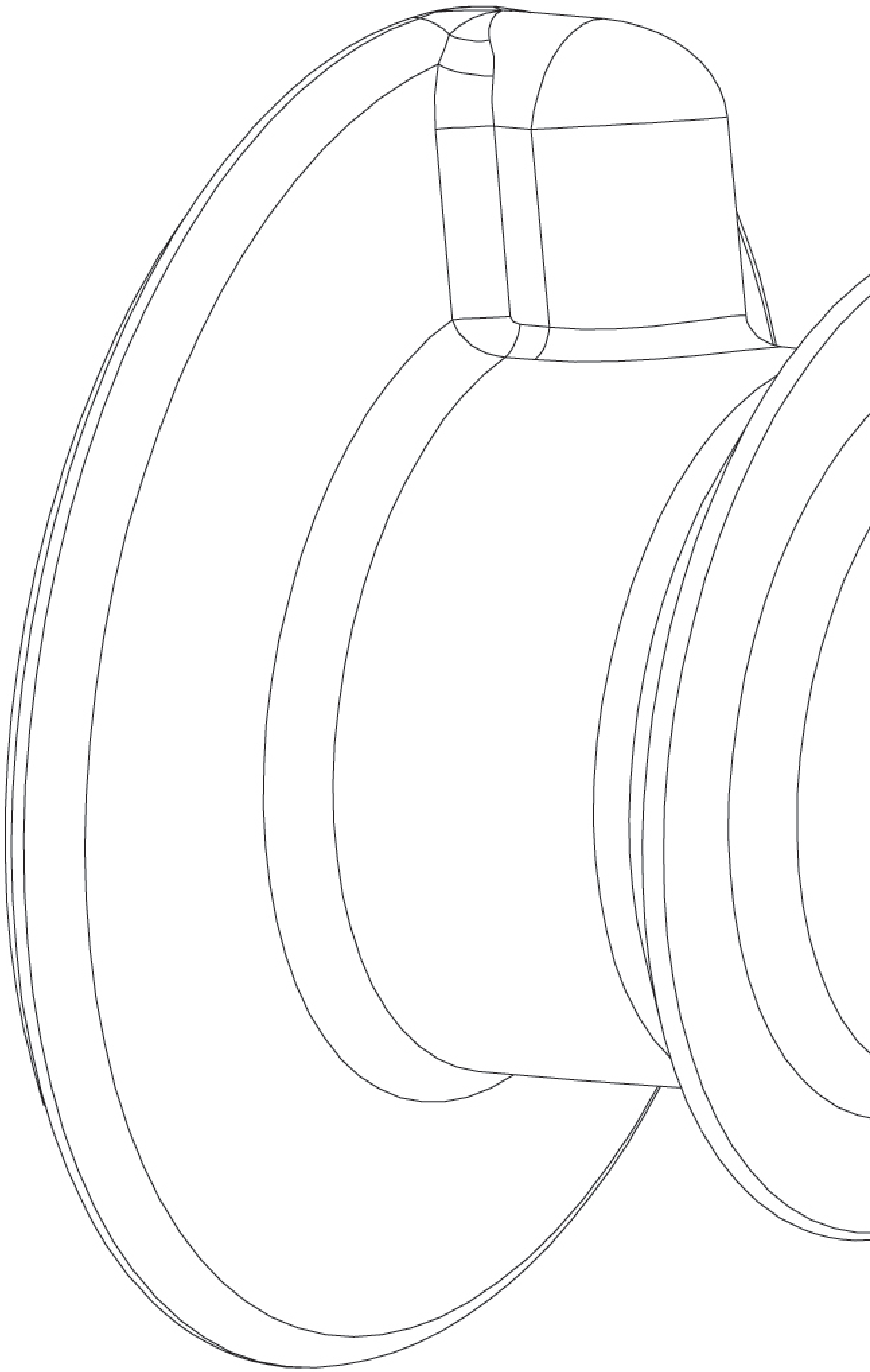
- Confirm with Main Contractor's representative that concrete has achieved a minimum compressive strength of 24 MPa required for final stressing. It is the Main Contractor's responsibility to keep the Engineer fully informed
- Place “banana” stressing block or barrels on all strands in each tendon
- Make sure banana block is seated correctly. Check banana block for days
- Check wedges for foreign matter. Fit 3-piece wedges around strands in block
- Stress every strand in each tendon to full design load.
- Knock-off ' wedges before releasing jack pressure (or use automatic "knock-off ' nose with jack).
- When all strands are stressed, measure distance between wedges and paint mark and enter value on record sheet, within an accuracy of 1.00 mm.
- All actual elongations/extensions shall be (±) 10 percent of the theoretical elongations/extensions.
- Submit records to the Project Engineer as soon as possible for checking and formal submission for approval.

METHOD

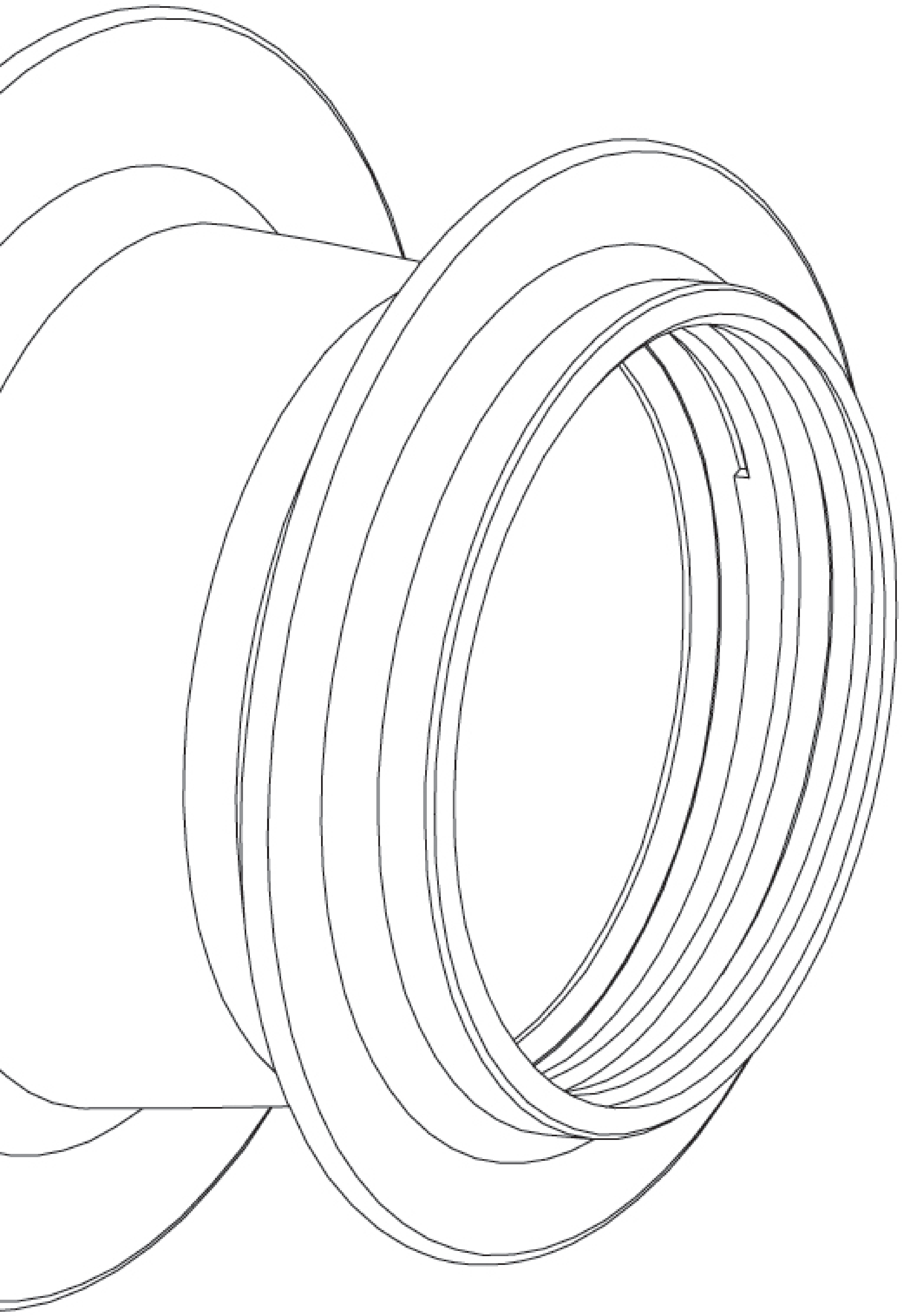
CUTTING OF STRANDS AND SEALING OF RECESS

Before cutting of strands, check the followings:

- That all strands have been stressed to required load, and the extension records have been submitted to the Project Engineer
- That approval to cut all strands has been received in writing
- Use the grinder to cut back the exposed strands so as to give minimum of 25mm cover to the external concrete face.
- Once the dry pack has been thoroughly mixed, begin filling the pocket by tightly packing the mix around the exposed anchor and strand.
- Once all cables have been cut and sealed and the dry pack has cured the slab is ready to be grouted



GROUTING TENDONS



- Prepare all necessary materials and equipment. Check all anchors are cut and sealed.
- Check pump/mixer is in working order and hoses clear.
- Check cement is fresh
- Recycle water in pump/.mixer.
- Add additive.
- Mix and recycle for 2 minutes.
- Add cement slowly, I bag at a time, until consistent mix is obtained.
- Continue to add cement until 200kg has been mixed, (recycling mix at all times)
- Tidy up all cement bags and dispose of correctly
- Position bucket at far end bleed tube. (to catch excess grout).
- Connect grout hose to near tube and start pumping
- STOP PUMPING, and close off near tube.
- Repeat steps 11 to 13 for all tendons until deck/pour complete.
- When complete, pump excess grout to waste area agreed with builder
-
- Wash and clean down mixer and flush hoses until clean
- Store equipment i n secure, safe location
- On the day following completion of grouting ng, all tubes to be cut off flush with
- Concrete, and deposited in rubbish area.

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