

Technology III

An Introduction to Tilt-up Construction



Tilt-up Construction

What is tilt-up construction?

...the prefabrication of large slender wall panels on the structural ground floor slab or on a prepared bed and erecting them into position using a multi-point lifting technique which allows lift with a tilt at relatively low concrete stresses



Tilt-up Construction

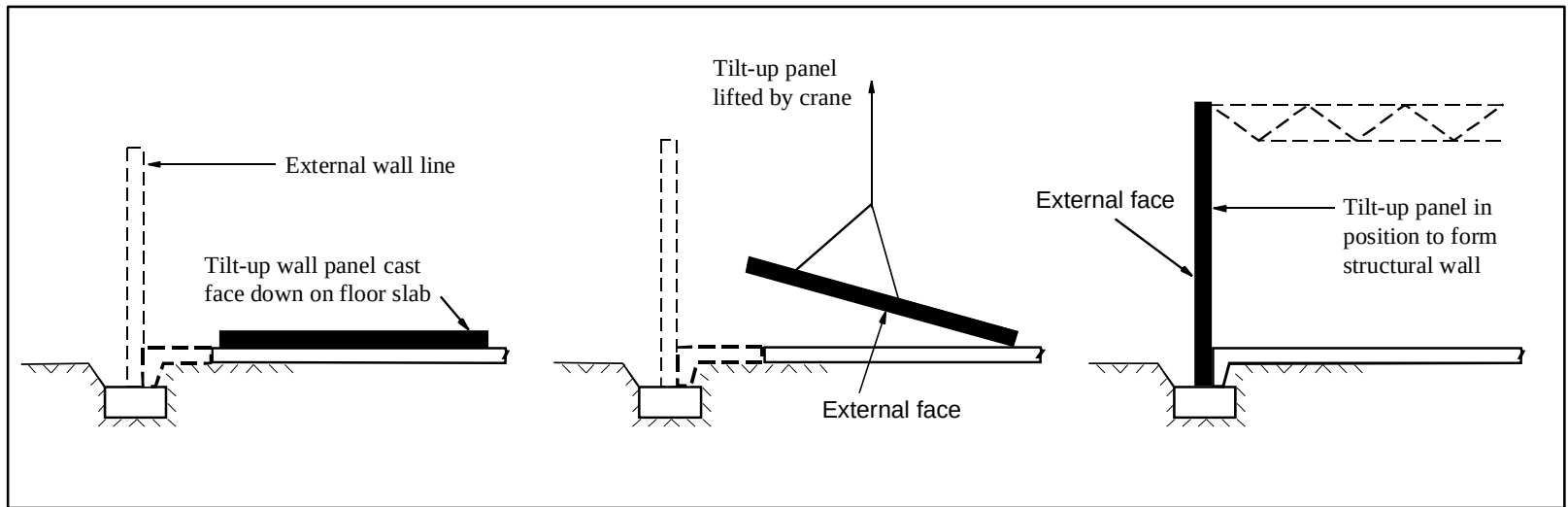
Why Tilt-up?

- In-situ concrete walls can be costly and slow
- Tilt-up = 'factory production' on site



- Typical construction sequence...

Tilt-up Construction



Principally for the construction of low-rise commercial and industrial structures on open sites

Room for casting

Lifting equipment



Tilt-up Construction



- Tilt-up can be used for a range of other structures...
 - industrial buildings including factory units and warehouses
 - commercial buildings up to 4 stories
 - bulky goods centres
 - shopping centres
 - school buildings
 - sport facilities
 - churches
 - two storey townhouse and multi-unit residential
 - motels and resorts
 - retaining walls



Tilt-up Construction

Advantages include;

- Excellent load bearing capacities
- Durability
- Fire proofing and sound attenuation qualities
- Speed and easy build
- Economical way of construction
- Architectural versatility with shapes and finishes
- Industry has the necessary resources for such work
- Cost competitive

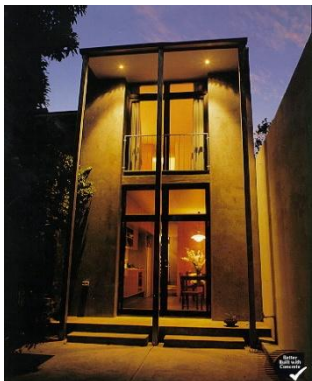


Tilt-up Construction



- Sound reduction - 50dB v < 30 for metal skins
- Architectural expression - new and versatile.....
- Robust, easily sealed surfaces – especially sandwich panel for cleanroom, food/drug etc
- Energy conservation - airtightness, thermal mass, insulation
- Plus safe working at ground level, potentially reduced insurance costs and maintenance costs

Tilt-up Construction



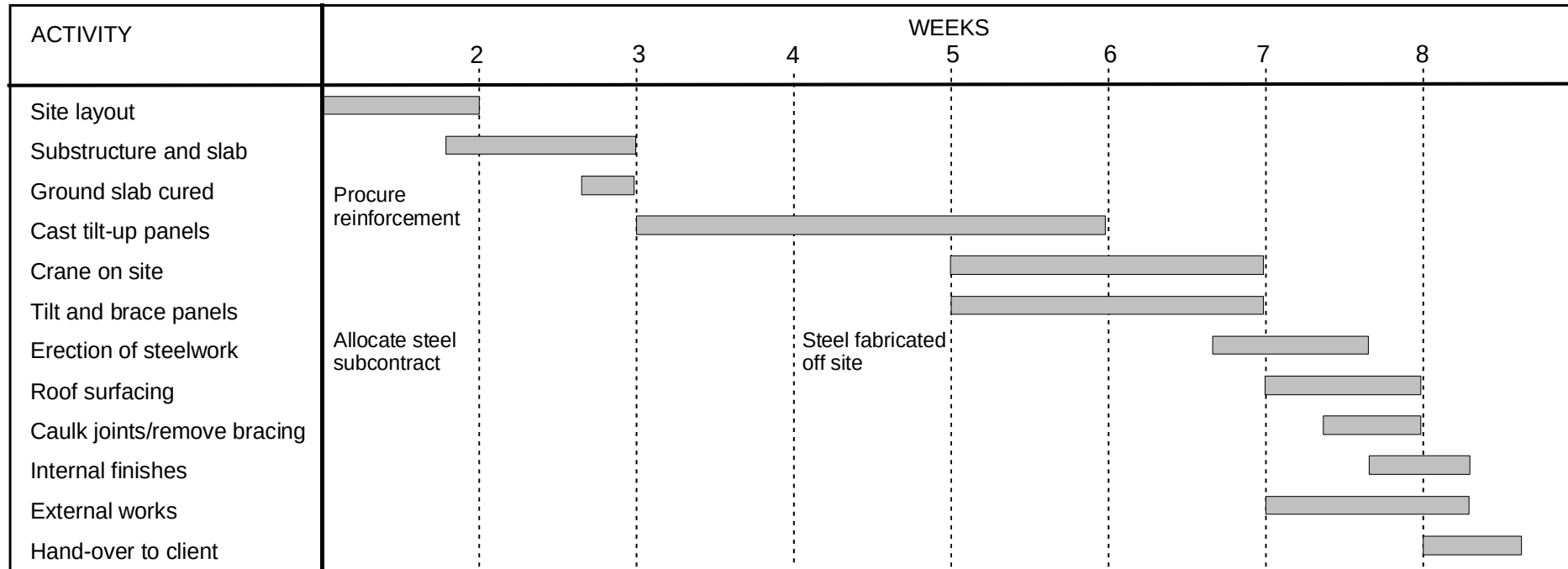
building costs/m² gross floor area

Based on 1997 costs

Type of external wall		Building A 2,304 m ² Eaves height 6 m	Building B 4,500 m ² Eaves height 8 m	Building C 9,180 m ² Eaves height 10 m	Building D 18,090 m ² Eaves height 12 m
Loadbearing tilt-up panels	TU	£360	£324	£319	£292
Tilt-up insulated sandwich panels	TU	£374	£338	£329	£299
Decorated tilt-up panels	TU	£361	£326	£320	£292
Tilt-up cladding panels	Hybr	£355	£327	£327	£294
Built-up metal cladding system	Trad	£342	£320	£321	£288
Composite cladding panels	Trad	£387	£360	£357	£318
Aluminium cladding system	Trad	£421	£391	£384	£339
Blockwork/built-up cladding	Trad	£354	£328	£327	£292

Tilt-up Construction

Construction Speed: 11,000m² warehouse USA

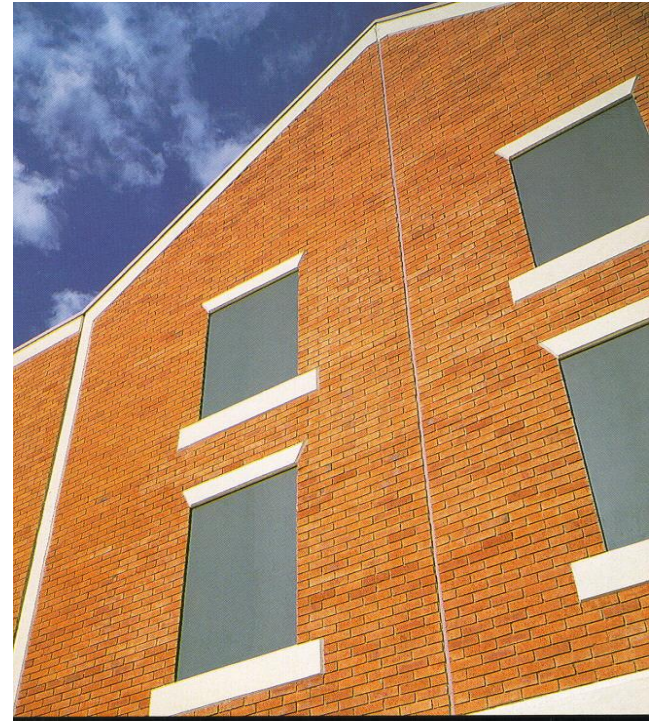


Note: approx 70 panels used

Tilt-up Construction

Range of finishes available including:

- Smooth or slightly textured painted finishes
- Ribs and textures from formliners



- Brick slips and inlaid stone features
- Reveal strips and niches for extra depth (sometimes called trompe l'oeil)
- Large scale company motifs or graphics can be cast in to the panel for added impact

Tilt-up Construction



Casting

- individual panels
- combined strip
- stack cast

Bond breaker needed
to separate panels
from panels and
panels from floor slab

Adhesion to slab can increase lifting stress by 20%!

Tilt-up Construction

Key design & construction management areas;

- Planning
- Design for lifting
- Design in service



Tilt-up Construction

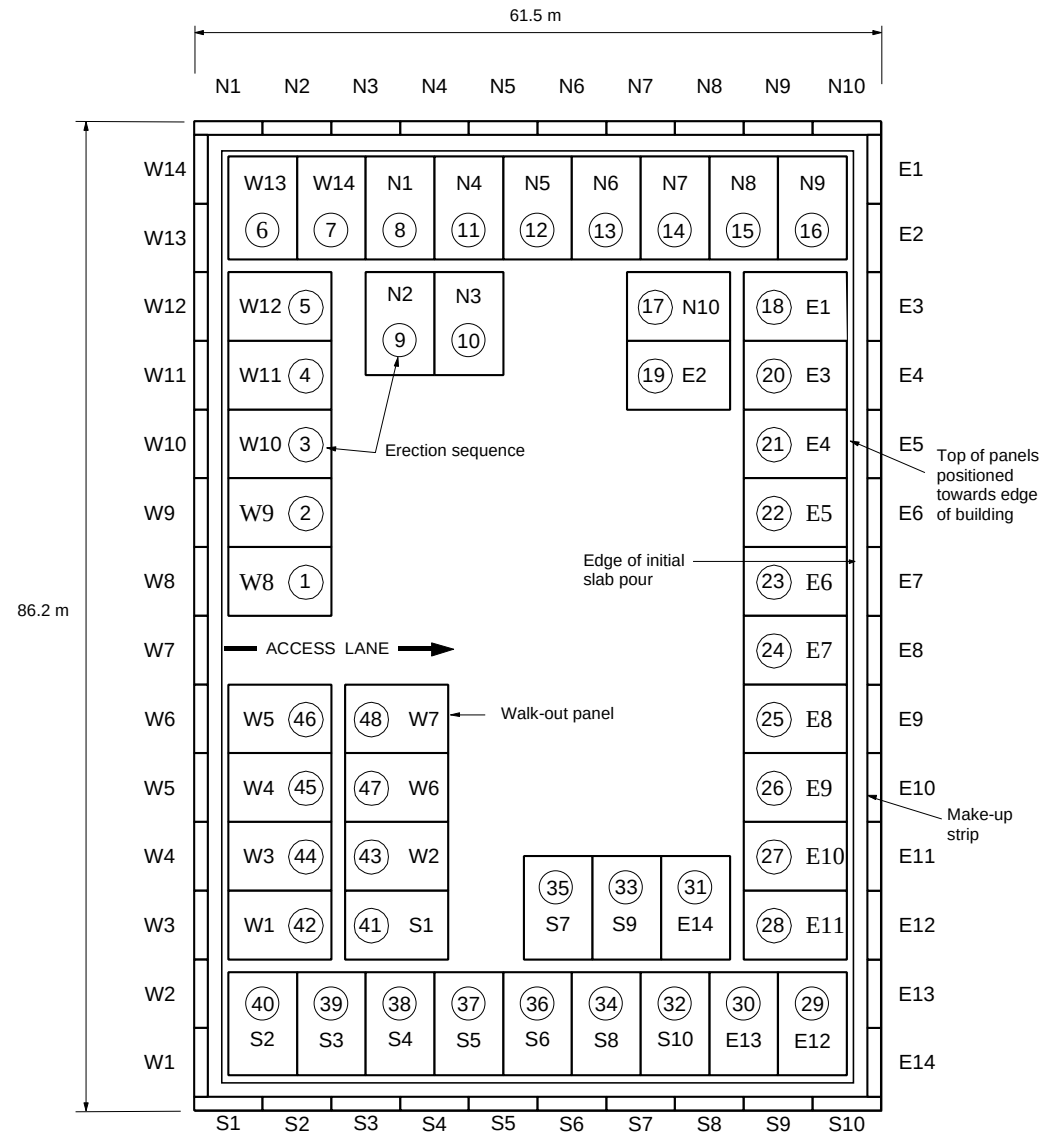
Planning: Optimising for construction

- Wall / floor ratio - max 70-80% or else use stack-casting
- Panel size - typically 7.5 to 9.0 m by 7.0 m
- Panel thickness - 150 - 180 mm (slender)
- Panel weight - 15 to 35 tonnes (15 to 25 typical)

- Building size - 2000+m² but lower possible/viable
- Size of site - not critical (e g large or confined ok)



Tilt-up Construction



Panel layout and erection sequence

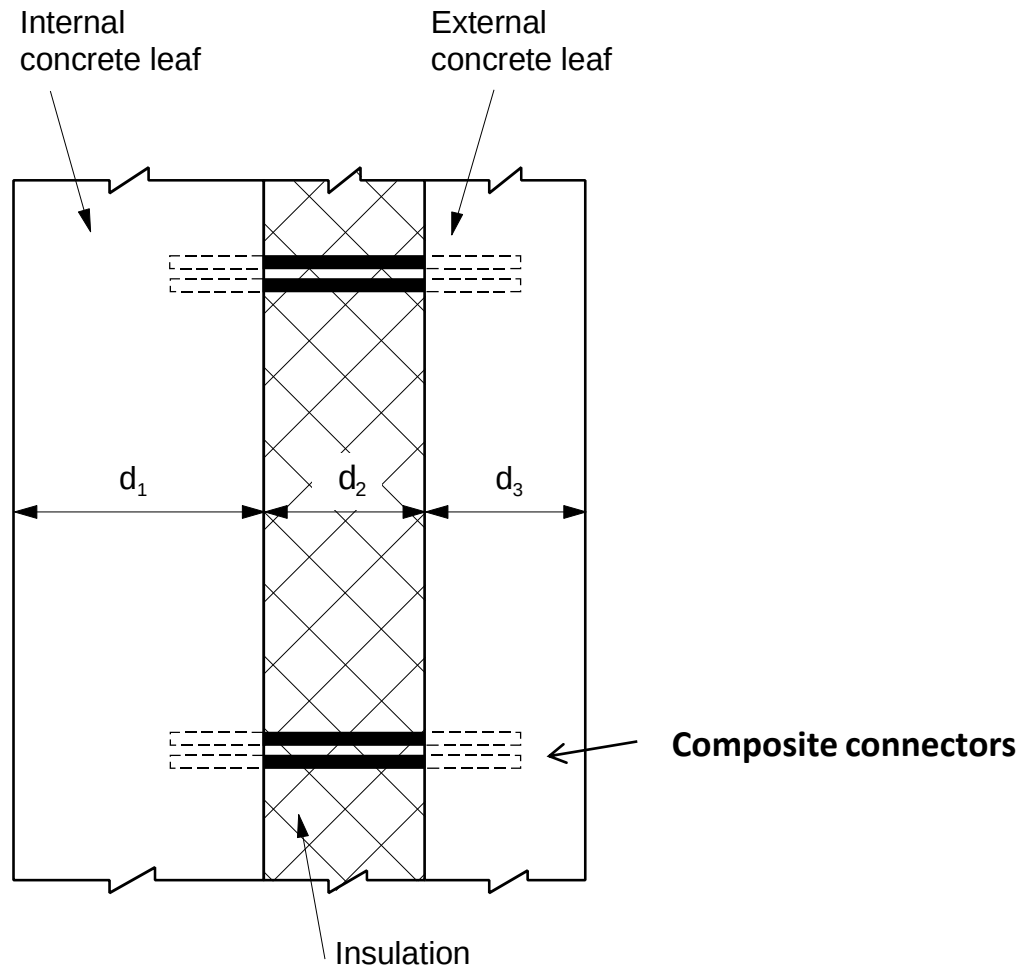
Tilt-up Construction

Typical details at the setting out stage

Window breakout



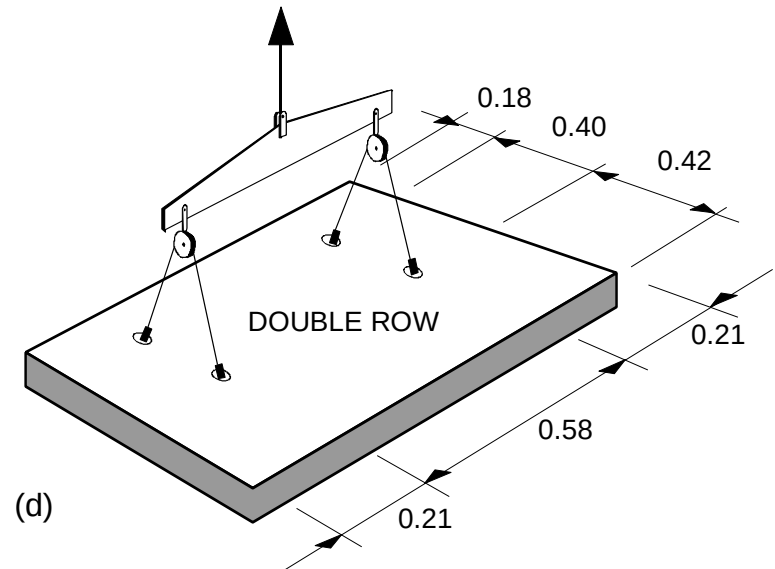
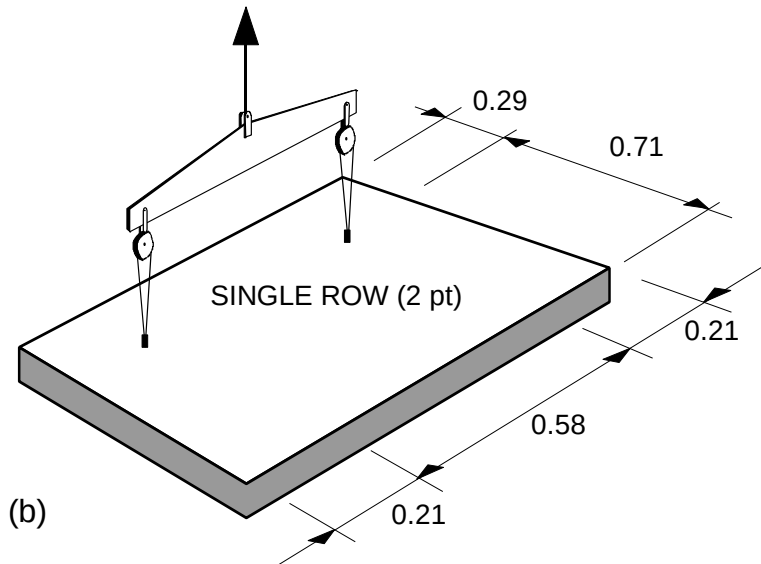
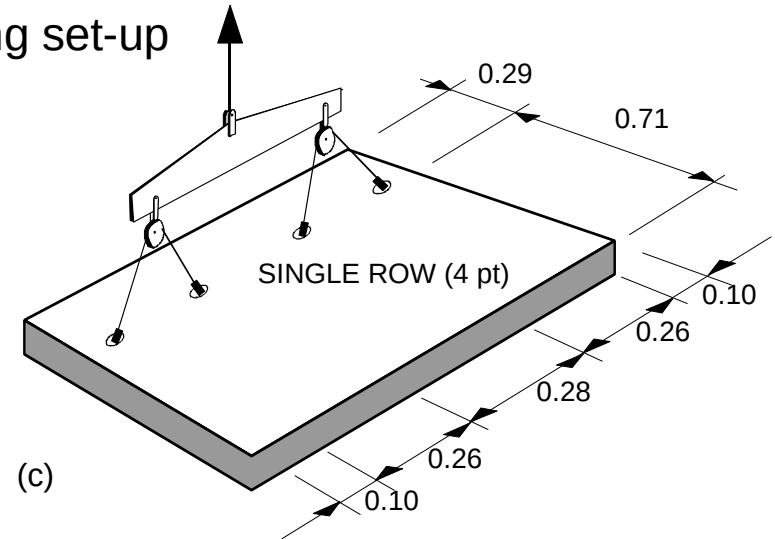
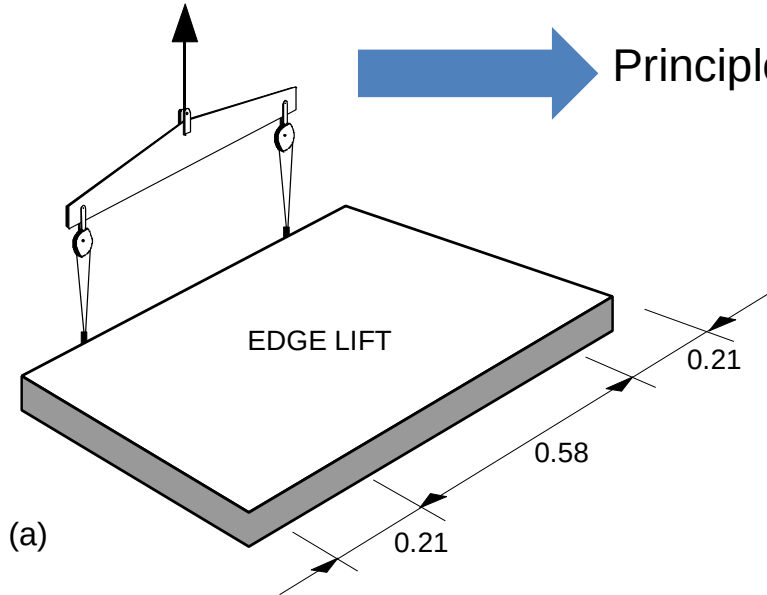
Reinforcement



 Typical cross section of a concrete sandwich panel with steel ties



Principles of lifting set-up



Tilt-up Construction

Design for lifting

Design of panels complex in concept but made simple by use of computer programs

Generally most lifting hardware suppliers are able to design the panels for lifting in consultation with the tilt-up contractor



Design takes into account the strength of the reinforced concrete panel necessary to suffer the stresses induced in the panel as it is lifted into the vertical

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Reinforcement

Not often used for lifting except for panels with large openings in absence of strong-backs

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Strong-backs

Typically steel sections used for strengthening panels of odd shape or with large openings

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Lifting hardware

- Hardware - provided in many arrangements - UK availability
- Inserts - Special quick release (ground release) for ease of construction



Tilt-up Construction

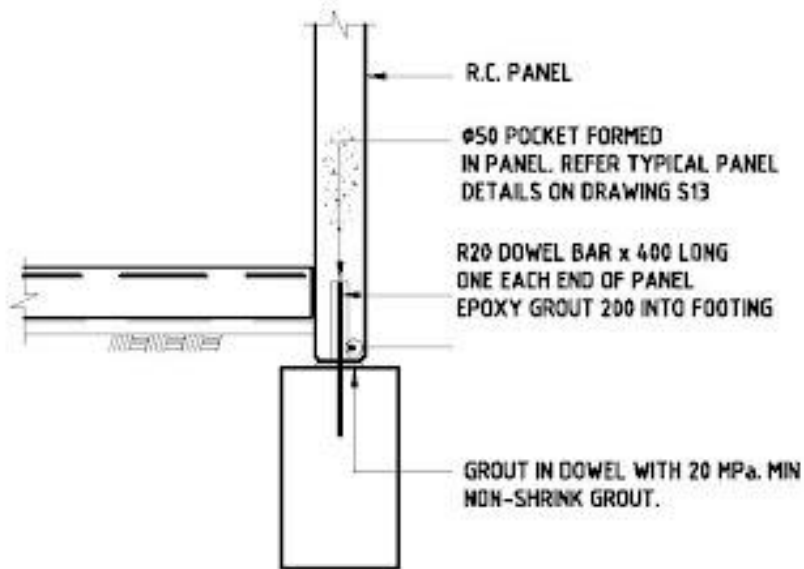


- Designed loads
- Spacing
- Access
- Risk ownership

Temporary propping



Tilt-up Construction



PANEL TO FOOTING DETAIL

Foundation detail

- Continuous deep strip
- Setting out
- Ground conditions
- Tolerances

Tilt-up Construction

Roof connection

- Lightweight
- Flexibility



- Spans
- Stability

Tilt-up Construction

Future for Tilt-up

- Cost competitive with compelling benefits
- MMC
- Construction efficiency drives & cost reduction, labour shortages, new methods
- Prefabrication, rationalisation, speed, security
- Energy efficiency, thermal mass, airtightness
- Whole life costs recognising extra benefits
- Sustainability



Tilt-up Construction

Discussion

Comment on the performance requirements of both the tilt-up system and the panels



Tilt-up Construction

Workshop

Examine the post construction benefits of tilt-up construction

Evaluate the areas of tilt-up construction that will demonstrate its environmental friendliness

