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2012 CAPTG Workshop

Runway Development Project
Calgary International Airport
MOVING FROM DESIGN TO CONSTRUCTION

September 17, 2012

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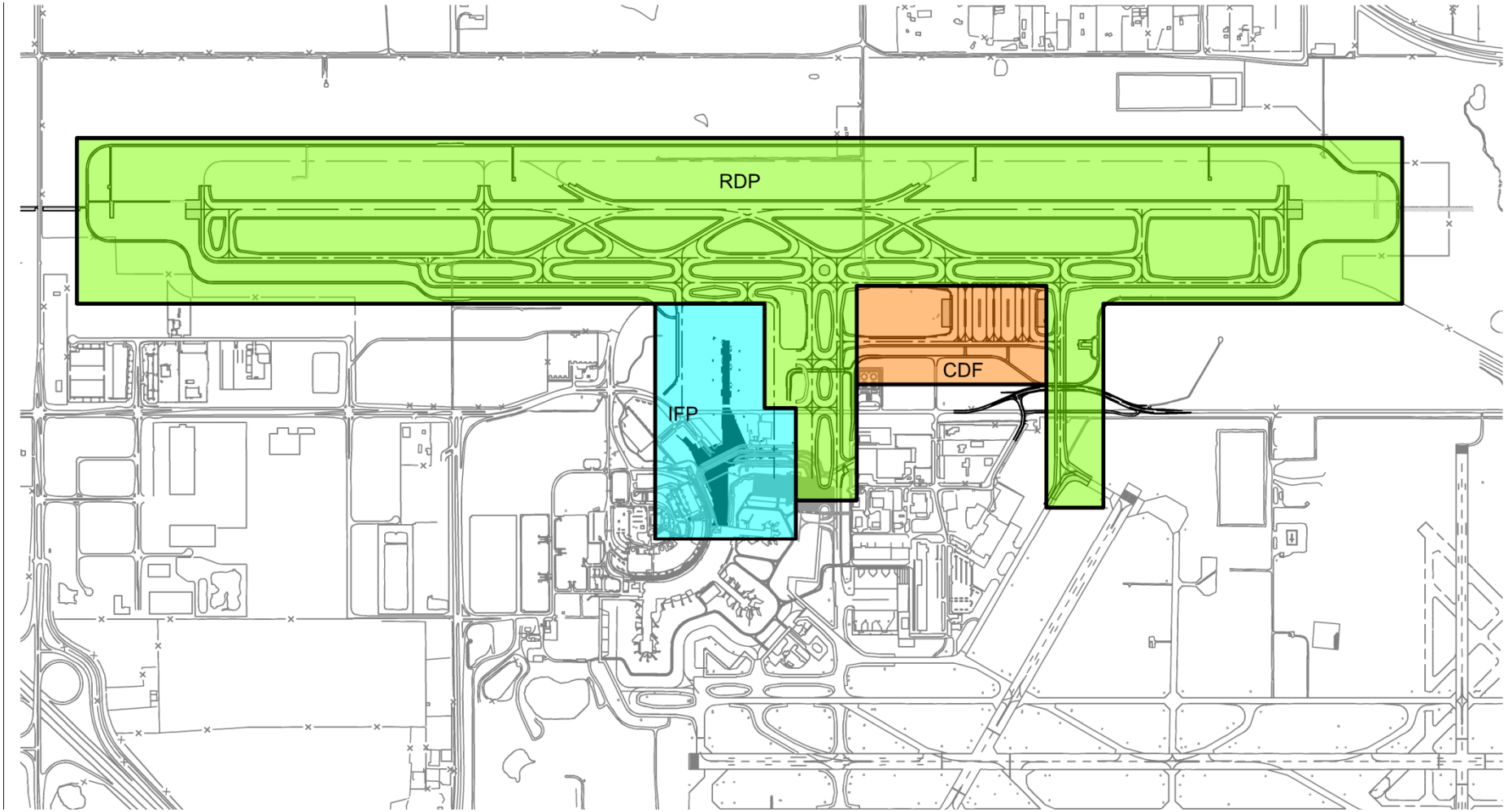
Prime Consultant Team

Overall Layout



Moving from Design to Construction

- Design packages completed in staggered timeframe, as needed for early construction
- Some construction started as some design was being completed, more like Design-Build
- Transition from design was a team effort by PC, PM, CM and Owner
- Transition is still taking place as construction progresses and design changes for efficiency

Design/Construction Schedule

- **WP 3 Earthworks package designed by PM early 2010**
- **Prime Consultant team AE and CH2M HILL started detailed design September 2010**
- **Construction Management team onboard late 2010**
- **First Designs ready for tender Spring 2011**
- **Construction started April 2011**
- **Runway project completion by May 2014**

Design Scope

- Preliminary design review
- PC detailed design scope of work divided into work breakdown structure
- Four major PC design packages:
  - WP 4 Deep Utilities
  - WP 5 Paving
  - WP 6 Airfield Electrical
  - WP 8 Taxiways J and R Underpasses
  - Overall Project Master Technical Specification
- Additional PC design package for Central Deicing Facility

Design Features and Challenges

- Overall balanced earthwork quantities
- Significant elevation difference between runway centerline and International Facilities Terminal Building
- Estimated embankment fill settlement in deep fill areas
- Estimated claystone/siltstone rock quantities
- Runway and Taxiway utility crossings: location, depth, settlement, pavement surface variation
- Storm drainage utilities
- Airfield electrical requirements
- Underpass design requirements

Design Package Sequence

- **WP 3 early for 7.5 million m3 of site work**
- **WP 4 to place utilities in cut/fill areas**
- **WP 5 to finalize CM Joint Venture paving scope and schedule**
- **WP 6 to define airfield electrical for tender and ordering long lead items and Field Electric Center**
- **WP 8 so earthworks, paving and electrical finalized for taxiways and for roadways relocation**

Construction Management JV

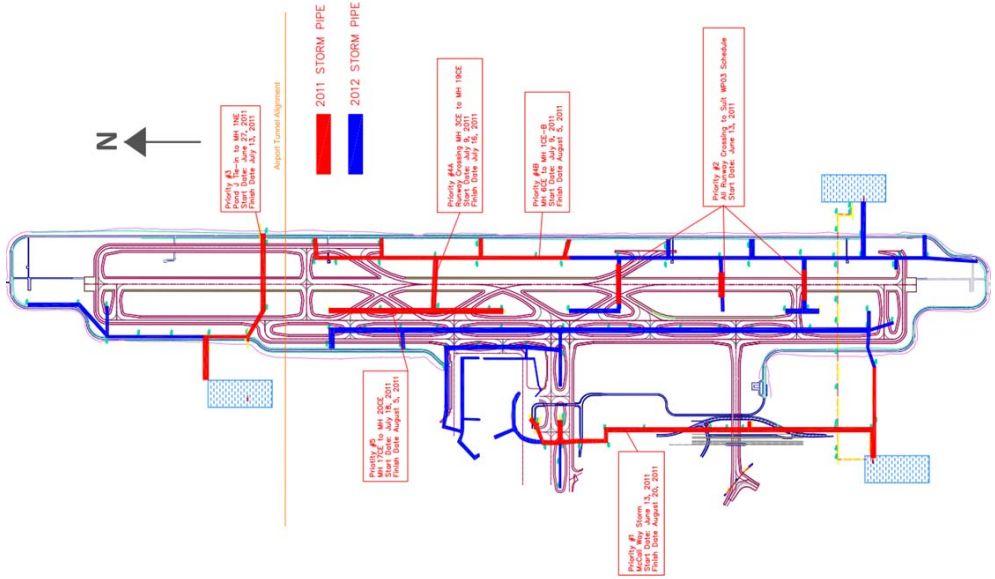
- **Design well underway before CM JV selected and under contract**
- **CM repackaged some design packages for tendering**
  - **WP 4 separated into 2 packages, storm and ducts**
  - **WP 5 asphalt separated from concrete paving**
  - **WP 6 separated into YYC procurement of ALCMS, generators, base cans and airfield electrical tender**

PM, CM & PC Coordination with Projects/Agencies

- **IFP – Interface limits earthworks, storm, paving, electrical**
- **NAV CANADA – ATCT and on-site Navaids power and communications, foundations**
- **ENMAX – Power supply to various locations**
- **Airport Trail Tunnel – Runway and parallel taxiway horizontal and vertical location**
- **Central Deicing Facility – Interface horizontal and vertical location and future area grading only**

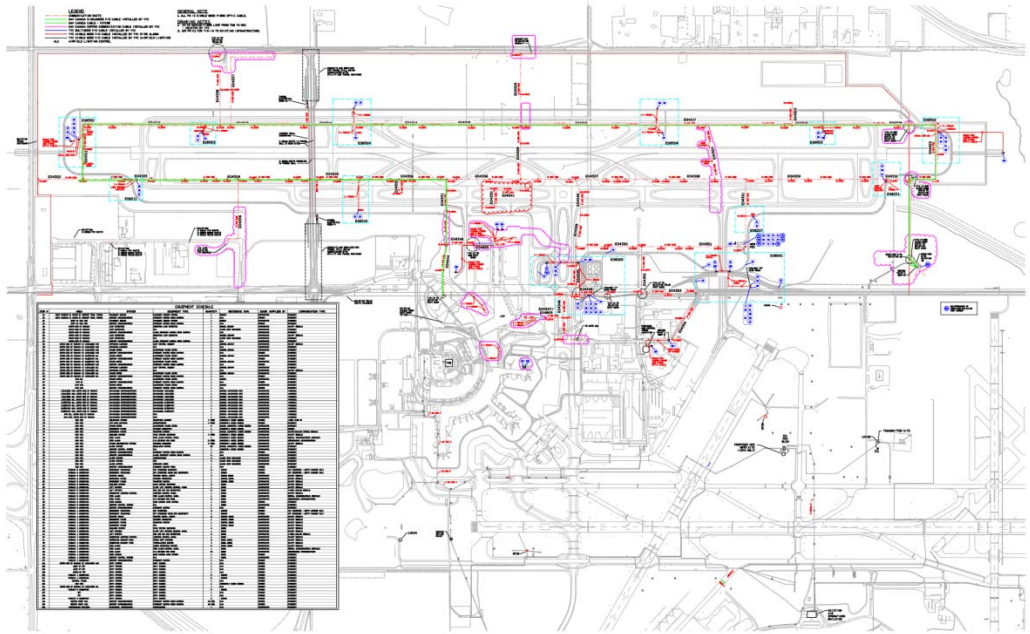
Storm Drainage

- **Pipe sizes minimized due to infield detention storage areas**
- **Aircraft loading for manhole structures**
- **Trench details standardized under pavement**



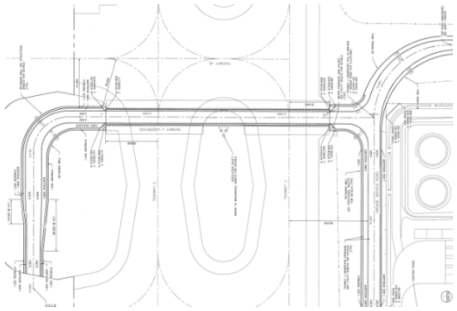
Duct Banks

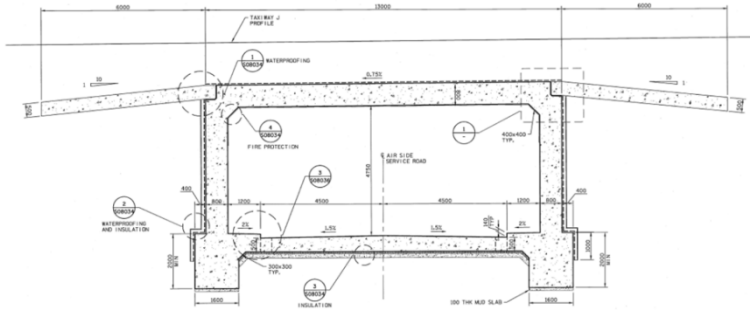
- **Efficient location of ENMAX duct bank service lines**
- **Size and number of on-site duct banks for power and communications combined for efficiency**
- **Diverse routing for communication**



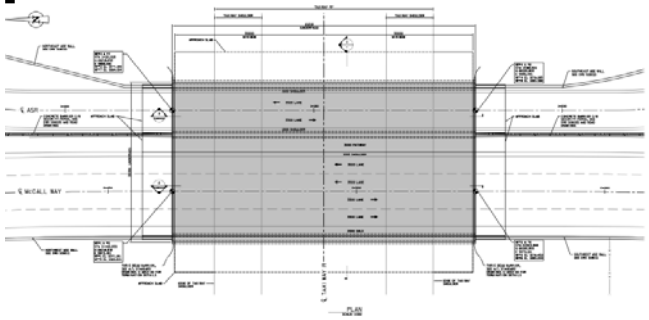
Taxiway Underpasses

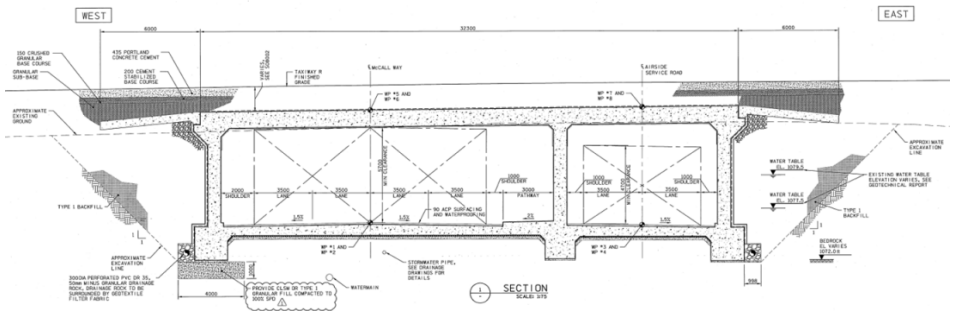
- **Taxiway J: 166 m length, 2 lanes, airside, adjacent to Jet Fuel Tank Farm (11 m depth excavation)**





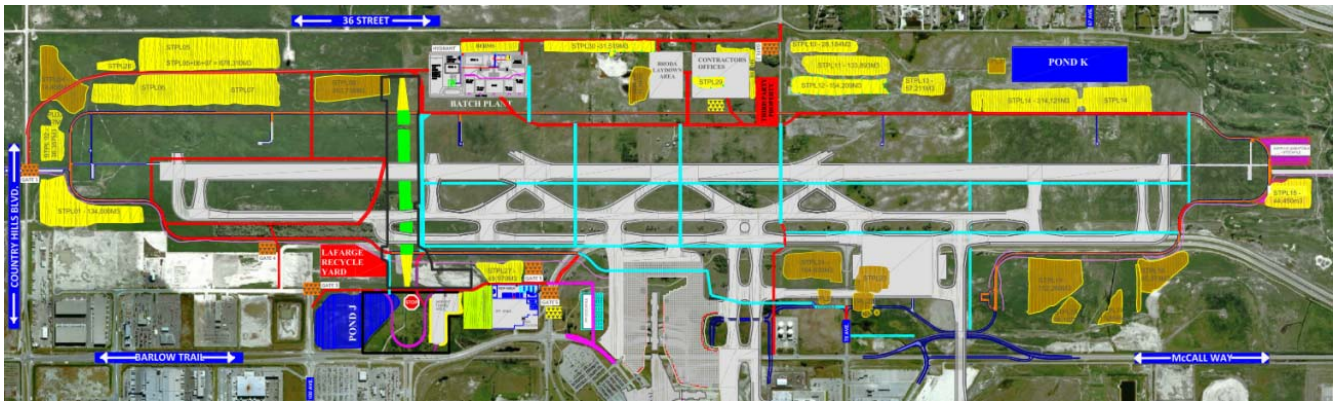
- **Taxiway R: 60 m length, 2 lanes airside, 4 lanes public**





Airport Trail Tunnel Impacts

- **Project added after runway/taxiway design complete**
- **Revised paving schedule to north of tunnel and south of tunnel**
- **Pavement section revised to include additional granular backfill over tunnel**
- **Haul roads for paving re-routed**



Construction Management

- **Earthworks material management plan updated regularly**
  - **Cut on north and fill on south**
  - **Best material placed under pavement**
  - **Overall balanced site**
  - **Estimate for excavation/fill embankment shrinkage**
- **Paving sequence adjusted for tunnel, weather and other contractors**
- **Electrical base can types revised for constructability and reduced impacts to paving**

Design for Ease of Construction, Examples

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- Geometry
- Concrete and asphalt paving
- Airfield electrical inset lights and approach lights
- Subdrainage installation for paving efficiency

Geometry

- **Runway 14,000’ (4,268m) long x 60m (196.8’) wide**
- **Code F capable (A380/B747-800)**
- **Details set by AeroTurn of largest Code F, A380**
- **Efficient pavement of all parallel and connector taxiways**
- **Clearly defined limits for airfield runway and taxiway clearance criteria; strip and graded area**

Concrete Paving Specifications

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- **Mix design**
  - **Required prevention of Alkali Aggregate Reactivity**
  - **Mitigation was low alkali cement & Type F flyash < 20%**
  - **Minimum flexural strength of 4.48 Mpa (650 psi)**
- **Smoothness by straightedge and profilograph**
- **Elevation by as-built surveying**
- **Grooving originally included, later deleted**
- **Texture for skid resistance 1mm depth, in-field measurement and checked friction factor**

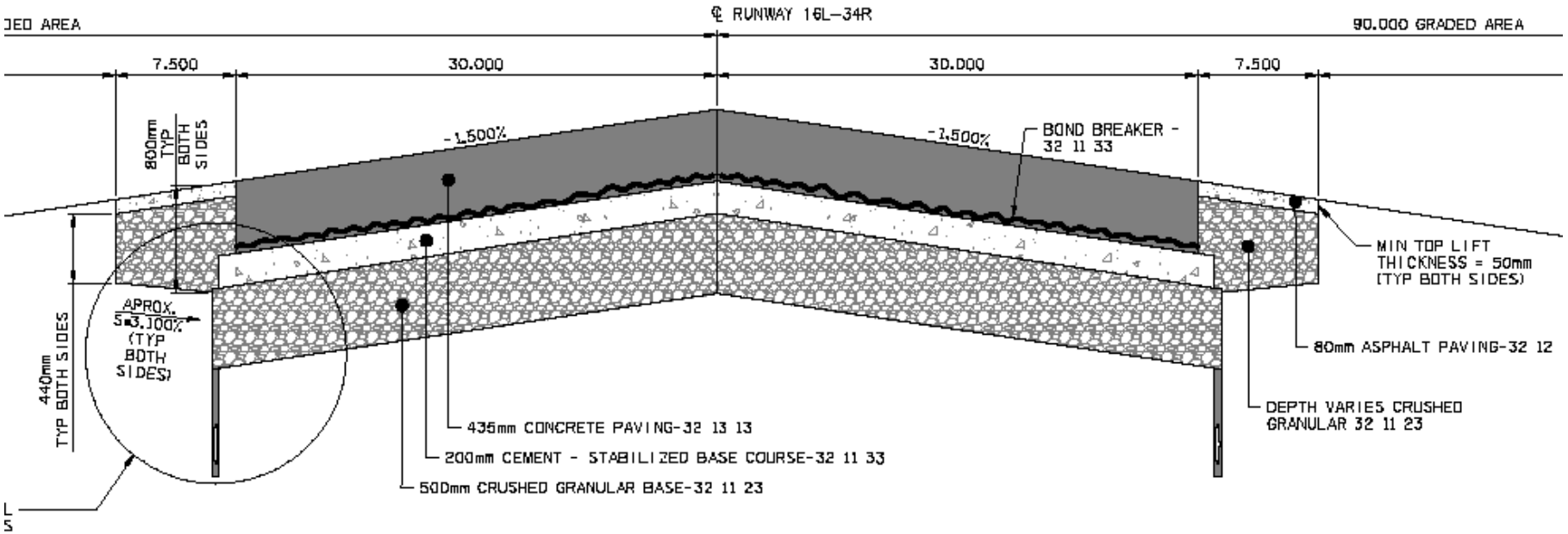
Concrete Design Features

- **Runway width 60m, 30m each side centreline**
  - **Longitudinal construction joint set at centreline, paving lanes 10m, so 3 lanes each side of centerline**
  - **Paving lanes 10m, so slabs sawed to 5m x 5m**
- **Taxiway width 25m**
  - **Longitudinal joint set at centreline, paving lanes 12.5m, so 1 lane each side of centreline**
  - **Paving lanes 12.5m, so slabs sawed to 6.25m x 6.25m (20.5’), which is maximum recommended**

Concrete Pavement Design

- **Subgrade support: CBR = 3, k = 22MPa/m (81 pci)**
- **Minimum frost protection is 1100mm (partial)**
- **Flexural strength of 4.48 Mpa**
- **Traffic based on AirBiz projections, annual growth of 3.3%**
- **FAA design software FAARFIELD**
- **Pavement designed early by PM, checked by PC**

Runway Typical Section



1 / - TYPICAL RUNWAY RIGID PAVEMENT STRUCTURE SECTION

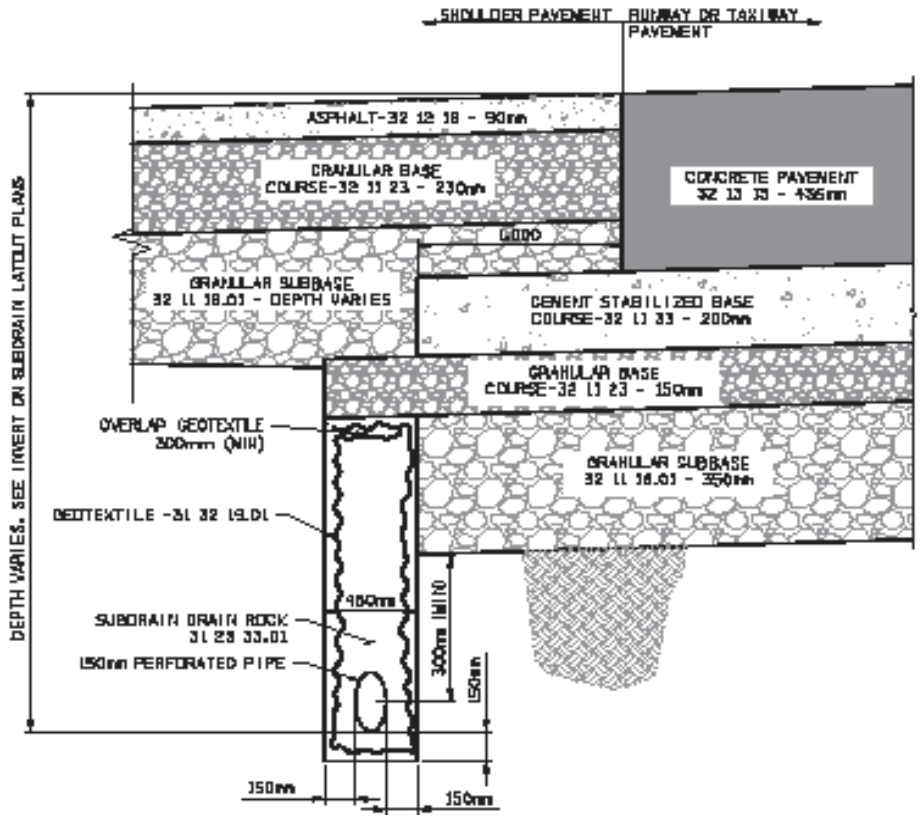
SCALE: HOR: 1:250
VER: 1:50

Asphalt Paving

- **Revisions during construction**
  - **Paved shoulder width analyzed using jet blast from AeroTurn and a 9.5m width selected**
  - **Shoulder width later reduced from 9.5m to 7.5m**
  - **Shoulder and Blast Pad thickness reduced from 90mm to 80 mm**

Subdrains

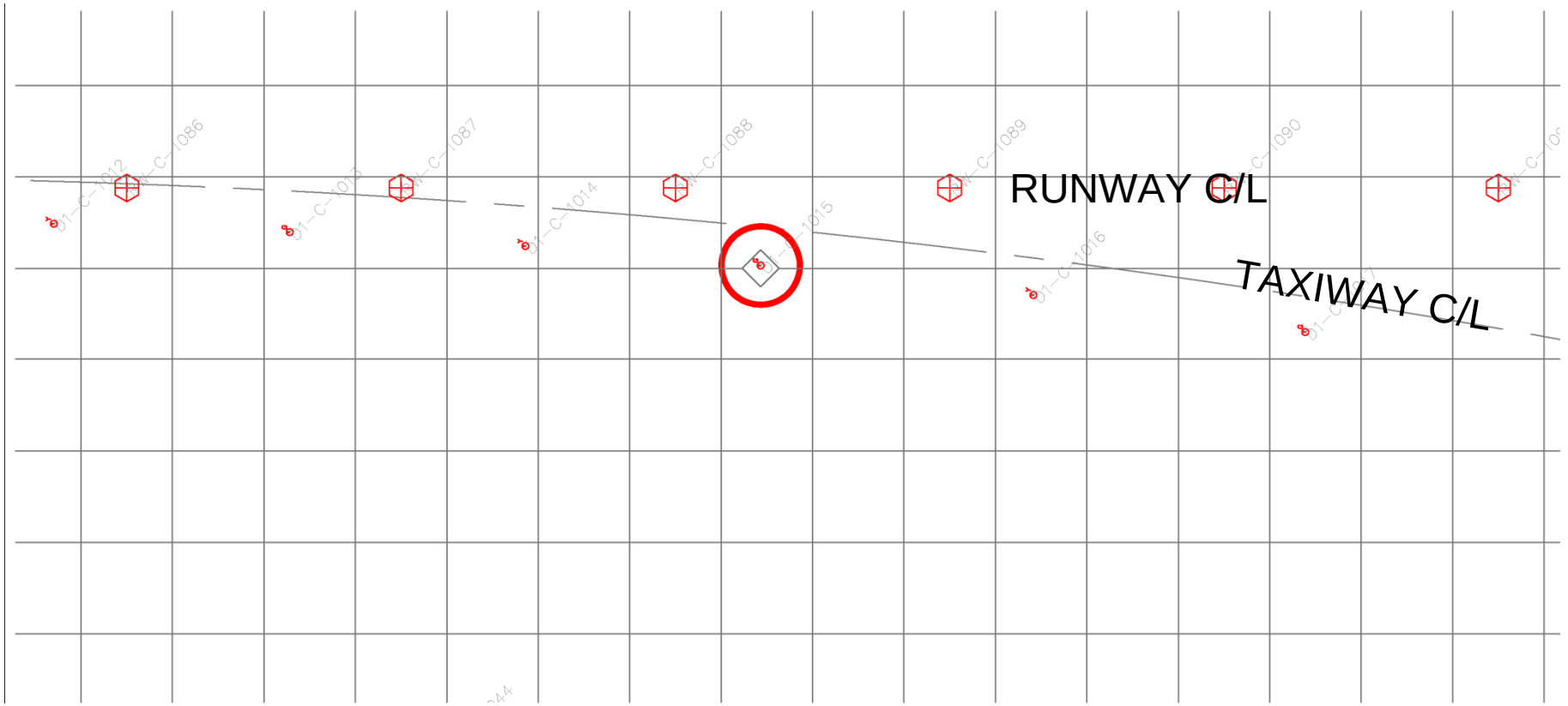
- **Designed for installation and paving efficiency**



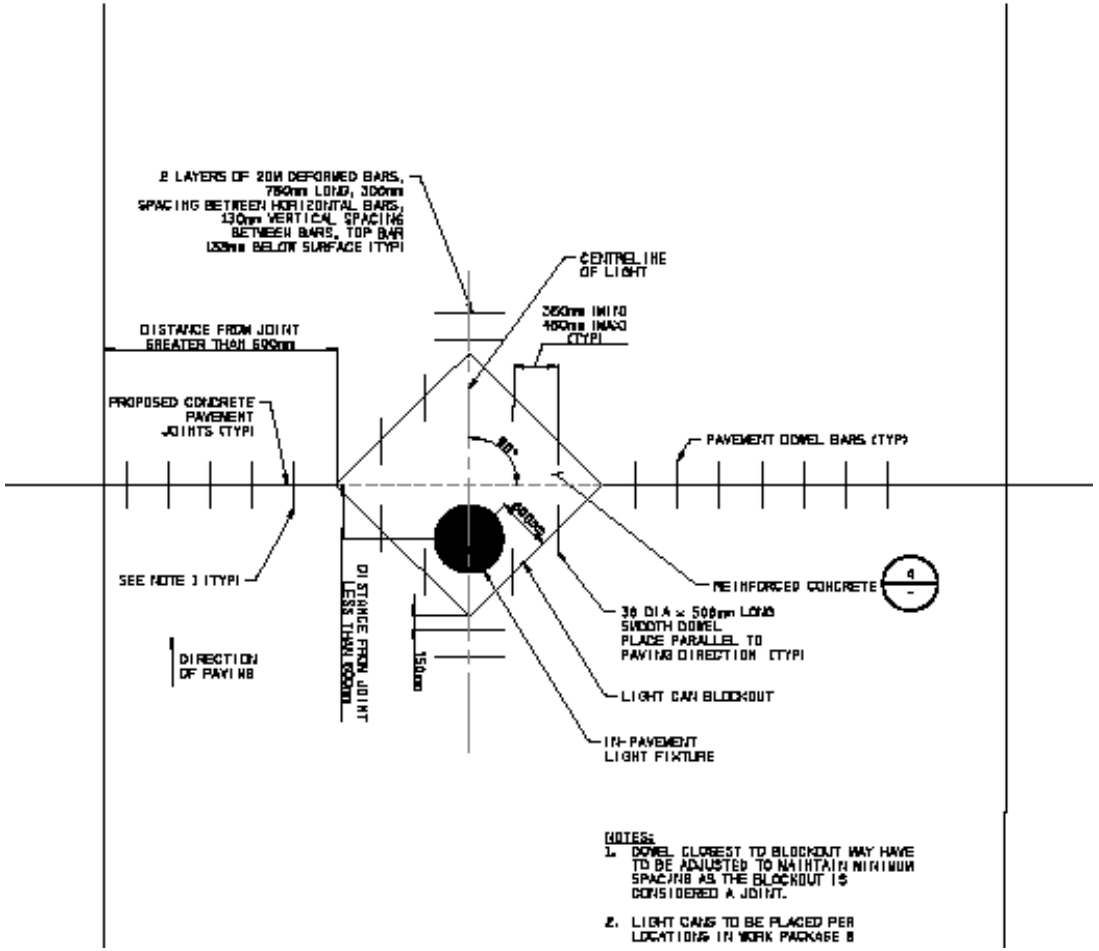
Airfield Electrical

- **SMGCS (low visibility) requires inset centreline taxiway lights at all locations, guidance signs, edge lights**
- **Inset lights designed to miss joints, 600mm (24”) for spalling**
- **Blockouts only used at 18 locations where base cans too close to joints**
- **Moving some transverse joints during construction**
- **CAT III Approach lights designed, Navaids**
- **New FEC for equipment and maintenance area**
- **New Airfield lighting control & monitoring system**

Light layout where Blockout Needed



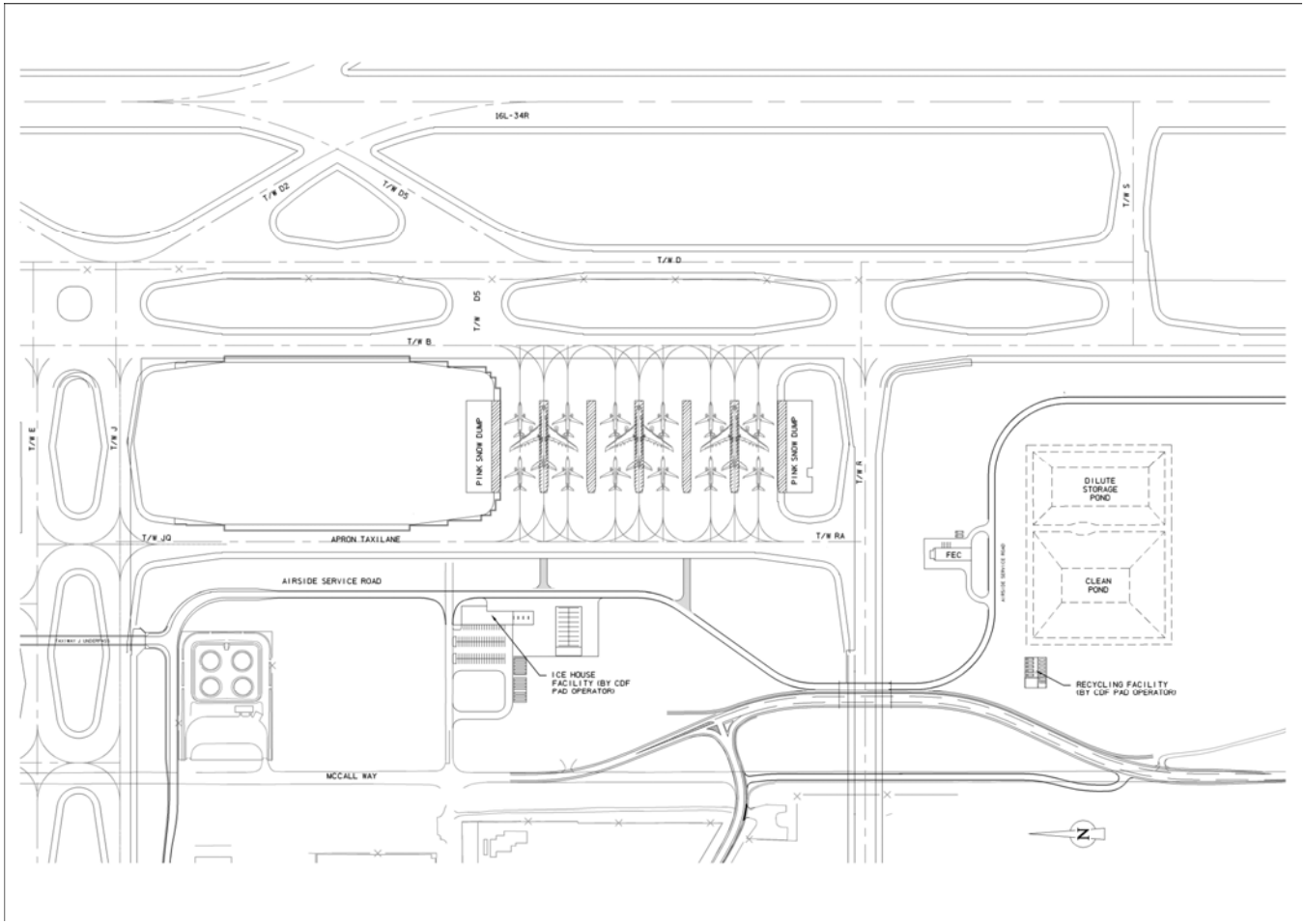
Concrete Blockout at Joint



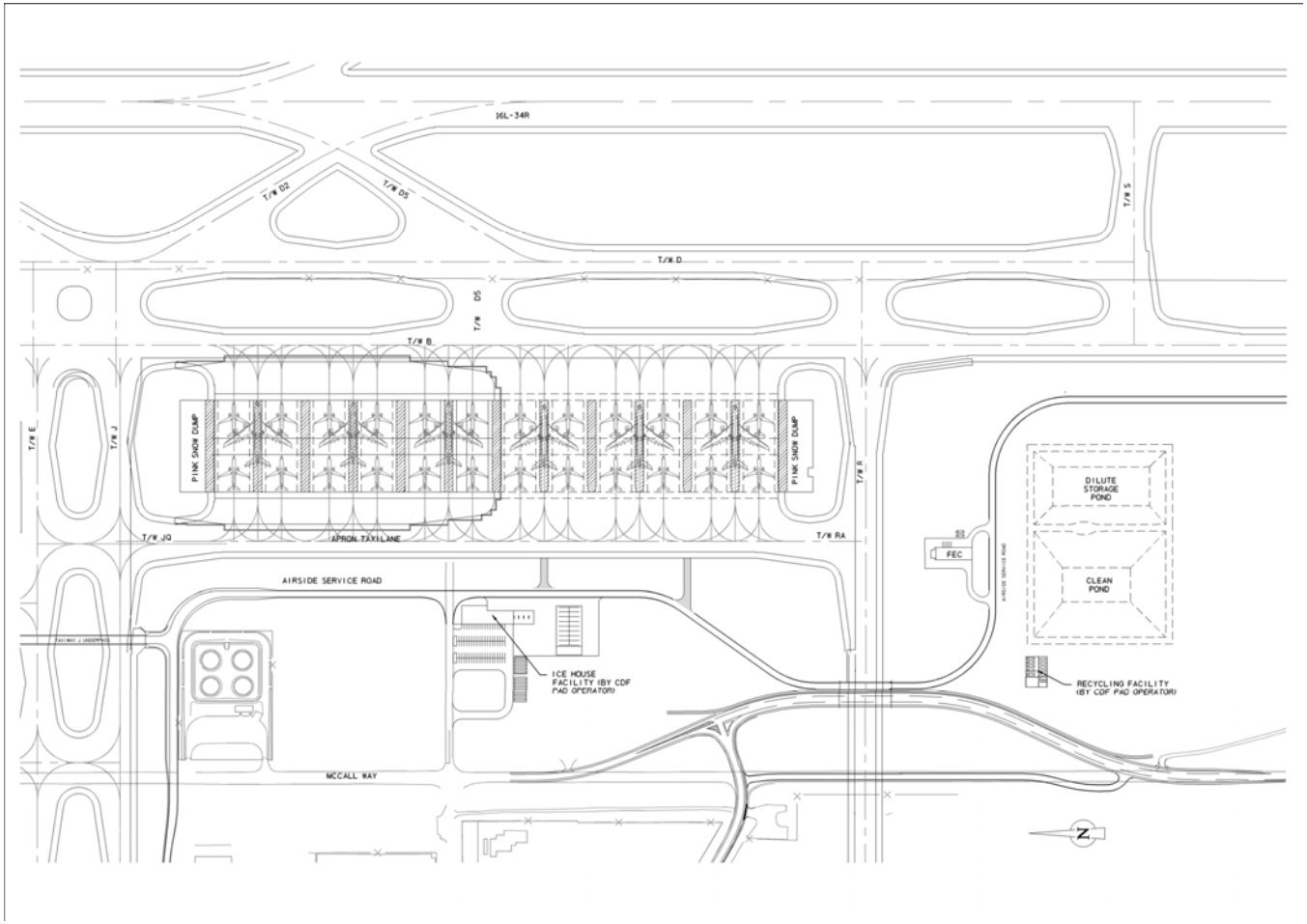
Central Deicing Facility Design

- **CDF separate design project**
- **Needed when IFP Terminal is open October 2014**
- **Design is 95% complete**
- **Construction by RDP contractors as change order**
- **Deicing fluid to storage pond and then discharged to City of Calgary WWTP**

Current Layout – 6 Deice Bays & 6 Queuing Spots (Code C



Future Layout – 12 Deice Bays & 12 Queuing Spots



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QUESTIONS?

ON BOARD
LET'S ROLL