

## REINFORCED CONCRETE BOX (RCB) VS. CAST-IN-PLACE ARCH (CIP ARCH)

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**Selecting the best and most economical solution for a drainage application requires careful comparison of all aspects of the project including:** Design, Hydraulic Efficiency, Installation Requirements, Quality Control, Risk, Time Requirements, and Total Installed Cost.

### DESIGN

- **Site Considerations:** RCB's minimize the required trench width to facilitate right-of-way requirements and properly 'fit' the drainage line to the project site and construction methods.
- **Product Design:** Precast RCB's are designed to ASTM and AASHTO Standards, which speeds up both the design and submittal process as well as providing known reliable product design, fabrication and test standards. Specific designs can be provided to the developer's engineer for inclusion into project plans and specifications.  
  
CIP Arch designs are not supported by ASTM or AASHTO Standards. The developer must depend upon the supplier for appropriate structural designs.
- **Performance:** Assure the drainage product can carry the required flow and support the intended loads while performing safely over the intended service life of the project.

### HYDRAULIC EFFICIENCY

- **Product Geometry:** Due to cross sectional geometry and corresponding wetted perimeter, RCB's provide greater flow efficiencies than CIP Arch. This means RCB's allow for a smaller structure for the same flow capacity which leads to lower installation costs.

Manning's n is laboratory confirmed for precast products to be 0.010 and field tests indicate 0.011 to 0.013 as appropriate design values. Surface smoothness of CIP Arch products may be consistent with precast RCB's but can vary from contractor to contractor.

### INSTALLATION

- **Excavation:** Excavation costs are less for RCB's than for CIP Arch since the structure is smaller. In addition to the wider CIP Arch structure, CIP Arch requires additional excavation to allow for construction of forms in the trench.

- **Backfill:** Installation requirements depend upon the support a structure requires from adjacent soils to assist in carrying the required loads. CIP Arch structures are dependent upon substantial soil reaction for proper structural performance. Consequently, the backfill soil type, placement and compaction are critical for CIP Arch structures leading to higher installation costs for CIP Arch than for RCB's.
- **Constructability:** RCB's are cured structures delivered to the jobsite and can be designed to allow for construction loads directly on the box which can significantly speed up the installation and backfill process. CIP Arch often requires backfill from both sides of the trench which increases installation time and cost.

## QUALITY CONTROL

In comparing a precast storm drainage product to one that is constructed at the jobsite, several additional benefits should be considered. For precast RCB's being manufactured in a controlled in-plant-environment:

- Materials are certified and tested in consistent and controlled manner.
- Steel placement is consistent and controlled assuring appropriate concrete-steel interaction to carry design loads.
- Product is measured and tested by in-house ACI certified technicians.
- Mix design consistency is assured through computer controlled batching operations.

## RISK

There is less risk to the Engineer, Developer and Contractor when using RCB's:

- RCB's are designed to proven AASHTO and ASTM National Standards.
- RCB's are backfilled immediately so there is no extended period with open trenches.
- RCB's do not require contractor personnel to be in the trench for extended periods for on-site forming and pouring processes.
- RCB quality is reliable because product is manufactured in a controlled in-plant-environment.

## OVERALL COST

The cost of installing RCB's is less than CIP Arch:

- Less material to be excavated.
- Fewer backfill lifts are required.
- Less compaction time is required.
- Immediate backfill possible since concrete is already cured to required strength when placed in the trench.
- Less time is required to complete installation.
- Less risk due to reduced open trench time.