Introduction to
Roller Compacted Concrete (RCC)

by

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COURSE OBJECTIVES

This course presents an introduction to the subject of Roller Compacted Concrete (RCC). The contents of this document are intended to serve as guidance and not as an absolute standard or rule.

The objectives of this course are:

- To provide relevant technical information on Roller Compacted Concrete (RCC) pavements
- Present its advantages and limitations
- Recommend factors to be considered when choosing a RCC.

Some of the topics for consideration include: the advantages of using roller compacted courses; limitations or past problems; current RCC mix design and usage; and real world examples. Course research data will be used to provide material for generating any conclusions and recommendations for Roller Compacted Concrete (RCC).

Willow Creek Dam – World’s First All-RCC Dam
(Ref: US Army Corps of Engineers. Walla Walla District)
INTRODUCTION

What is Roller Compacted Concrete (RCC)?

Roller Compacted Concrete is a Portland Cement product that is installed like asphalt pavement. It is a durable paving material used for off-highway pavement projects, heavy-duty parking and storage areas, dams, and as a base for conventional pavements. RCC is a less than zero-slump concrete mixture that is placed and compacted with the same equipment used for asphalt paving. It is a fast, economical construction method that requires no forms, finishing, or surface texturing.

The American Concrete Institute (ACI) definition of Roller Compacted Concrete states that RCC is “concrete compacted by roller compaction; concrete that, in its unhardened state, will support a roller while being compacted.” Although many of the properties of RCC are similar to conventional concrete, Roller Compacted Concrete can also be made with hardened properties outside the typical property ranges. RCC has also been referred to in the past as “rollcrete” and “rolled concrete”.

RCC is a very stiff Portland cement concrete that is normally mixed in continuous pug-mill mixers near the job site. The mix is then hauled to the paving site in non-agitated trucks, placed with pavers, and compacted with vibratory and pneumatic-tire rollers (until compaction reaches 95 to 98% of the maximum density). The paver can place the mix in layers up to 10 inches thick. To finish the process, a mist of water is applied to the pavement. Curing times can be as short as one day. RCC forms a strong and durable concrete pavement that is more economical to place than using conventional Portland cement placement methods.

RCC is a zero slump concrete mixture with the consistency of damp gravel. This allows the mix to be placed without the use of forms. It has the same basic ingredients (cement, water, and aggregates), mixture properties, and engineering properties as conventional concrete. RCC mix proportions are not too different from conventional concrete. Beams using Roller Compacted Concrete have produced flexural strengths exceeding 650 psi at 28 days. Fatigue characteristics are also similar to typical concrete paving. But unlike conventional concrete, RCC is a drier mix that is stiff enough to be compacted by vibratory rollers. Typically, it is constructed without joints. It needs neither forms nor finishing, and it does not contain dowels or steel reinforcing.
These characteristics make RCC simple, fast, and economical.

**DISCUSSION**

**HISTORY**
During the 1960’s, the logging industry began using Cement Treated Base with an asphalt overlay to carry heavy loads of the Oregon sorting yards. The industry needed a strong and economic pavement to stand up to oversized loads from heavy specialized equipment. In 1976, a log sorting yard on Vancouver Island, British Columbia increased the cement content of the soil cement to increase the strength and freeze/thaw resistance of the mix. The asphalt overlay was delayed while the strength of the Cement Treated Base was assessed. The asphalt was never applied because the soil cement was so strong and Roller Compacted Concrete was born. Canada’s logging industry continues to use this method extensively.

In the United States, interest grew as the Army Corps of Engineers (USACE) began using RCC in dam construction. The first significant use as a paving material was at Fort Hood, Texas for a tank parking apron in 1984. During this project, important information was learned about curing, sampling, lift methods, compaction, and maximum aggregate size of Roller Compacted Concrete. At the same time, USACE built a full-scale test pavement at the Cold Regions Research Engineering Laboratory in Hanover, New Hampshire to test effects of climate conditions. The Corps went on to build projects at Ft. Lewis, Washington in 1985 and several other “equipment hardstands” from New York to Texas with RCC.

In the summer of 1985, The Port of Tacoma used Roller Compacted Concrete to build the South Intermodal Yard. The facility was paved with a conventional asphalt paver equipped with a vibrating screed. Half the yard was paved with a Barber Green asphalt paver equipped with a vibrating screed and the other half with a German-made ABG paver equipped with two tamping bars that consolidate the RCC before rolling. The ABG paver produced a nearly level surface.
Also in 1985, Portland International Airport built an aircraft parking apron and Burlington Northern Railroad paved a new intermodal facility at Houston, Texas with RCC. Between 1986 and 1988, Berths 11 and 12 of the Conley and Moran Marine Terminals in Boston were built using two to three lifts of Roller Compacted Concrete to produce a pavement 18 inches thick.

Experience has taught paving contractors in the U.S. and Canada that high density pavers produce satisfactory rideability in RCC pavements. Many cities use Roller Compacted Concrete for municipal paving projects because the reliability of RCC has been proven by over 30 years of use.

The Portland Cement Association (PCA) estimated that their mid-1980’s design charts provided conservative designs and thinner pavement layers can now be used due to advances in RCC concrete mix design. Today, Roller Compacted Concrete is used when strength, durability, and economy are primary needs: port, intermodal, and military facilities; parking, storage, and staging areas; streets, intersections, and low-speed roads.

ADVANTAGES

The high strength of RCC pavements eliminates common and costly problems traditionally associated with asphalt pavements.

- Resists rutting
- Spans soft localized subgrades
- Will not soften under high temperatures
- Resists deformation under heavy, concentrated loads
- Does not deteriorate from fuel and hydraulic fluid spillage

Economy was the mother of invention for Roller Compacted Concrete. The need for a low-cost, high-volume material for industrial pavements led to its development. RCC has the strength and performance of conventional concrete with the economy and simplicity of asphalt. Coupled with long service life and minimal maintenance, RCC's
low initial cost adds up to economy and value.

**ROLLER COMPACTED CONCRETE PERFORMANCE**

**High flexural strength (500 to 1000 psi) (3.5 MPa to 7.0 MPa)**
Supports heavy, repetitive loads without failure and spans localized soft subgrade areas, which reduces maintenance costs and down time.

**High compressive strength (4,000 to 10,000 psi) (28 MPa to 69 MPa)**
Withstands high concentrated loads and impacts from heavy industrial, military, and mining applications.

**High shear strength**
Eliminates rutting and subsequent repairs.

**High density, low absorption**
Provides excellent durability, even under freeze-thaw conditions; eliminates seepage through pavement.

**Low water content, low water/cement ratio**
Increases strength, reduces permeability, and enhances durability and resistance to chemical attack.

**Aggregate interlock**
Provides high shear resistance at joints and uncontrolled cracks to prevent vertical displacement or faulting.

**No steel reinforcing or dowels**
Speeds and simplifies construction, reduces costs.

**No forms or finishing**
Speeds construction, reduces cost, minimizes labor.
No formed or sawed joints
Speeds construction, reduces cost. (To enhance appearance, joints can be sawn into RCC pavement.)

Hard, durable, light-colored surface
Resists abrasion, eliminates need for surface course and reduces cost. The light color reduces lighting requirements for parking and storage areas.

Construction-cost histories of RCC and conventional concrete continue to show the unit cost per cubic yard of RCC is considerably less than conventionally placed concrete. Approximate costs of RCC range from 25 to 50 percent less than conventionally placed concrete. The difference in percentage savings usually depends on the cost of aggregate and cementing materials, the complexity of placement, and the total quantities of concrete placed. Savings associated with RCC are primarily due to reduced forming, placement, and compaction costs and reduced construction times.

The Roller Compacted Concrete construction process encourages a near continuous placement of material, making very high production rates possible. These production rates significantly shorten the construction period. Construction time for large RCC projects can be reduced by several months to several years. Other benefits from rapid construction include reduced administration costs and earlier project benefits. Basically, RCC construction offers economic advantages in all aspects of construction that are related to time.

While low cost continues to draw engineers, owners, and construction managers to RCC. Today's RCC owes much of its appeal to performance: the strength to withstand heavy and specialized loads; the durability to resist freeze-thaw damage; and the versatility to take on a wide variety of paving applications. From container ports to parking lots, RCC is the right choice for tough duty.
USES OF RCC

Off Highway Applications - Perfect for large, unrestricted paving areas at industrial sites with low-speed vehicles.

- Haul roads
- Military applications
- Tank hardstands
- Maintenance yards
- Intermodal shipping
- Truck terminals/distribution centers
- Airfield apron areas
- Parking and storage
- Dams

Streets & Highways - Not appropriate for high-speed traffic in its natural state, perfect foundation for a roadway built with a more uniform surface.

- Industrial access roads
- Residential streets
- Highway inlays
- Fast-track, high-volume intersections
- Shoulders and turn lanes

CONSTRUCTION PROCESS

The high-volume, high-speed construction installation methods of Roller Compacted Concrete distinguishes itself from other types of pavements. It combines the low cost concrete paving materials with an installation procedure similar to asphalt. The paving process requires an asphalt paver, vibratory roller and a rubber tire roller to place, compact and smooth the Roller Compacted Concrete. Since RCC does not use dowels, steel reinforcement or forms, the pavement can be placed very quickly. This is important
since one of the few drawbacks of the mix is that it must be placed and finished within one hour of being wetted.

Large-capacity mixers set the pace of construction for Roller Compacted Concrete. Normally, RCC is blended in continuous-mixing pugmills at or near the construction site to minimize transportation time. These pugmills have the advantages of being easy to transport, possessing a large output capacity, and providing a mixing efficiency needed to evenly disperse the relatively small amount of water used. For smaller jobs, a batch mixing plant may be used. For pugmills, a gobb hopper can be placed at the end of the final discharge belt in order to reduce segregation of the material caused by the free fall into the trucks. The mix is loaded into non-agitating trucks, usually dump trucks, which transport the material to the job site and discharge it into an asphalt paver, which places the material in layers up to 10 inches (250 mm) thick and 42 feet (13 m) wide.

The paver places the RCC on a base of crushed stone that has been wetted to prevent the base stone from drawing water from the concrete mix. The pavers can be equipped with vibratory screeds and tamping bars that allow the mix to reach up to 90 percent compaction directly out of the paver. A high initial compaction rate helps speed up the finishing process and provides a higher quality finished pavement for thicker lifts. A vibratory roller, usually ten-ton dual drum roller, will make two static passes over the RCC to set the surface. Vibratory passes follow the static passes until the desired compaction is reached (usually 2 to 4 passes). The surface of the Roller Compacted Concrete is then finished by several passes of a 10 to 20 ton rubber-tired roller followed by a final static pass of the vibratory roller to remove any roller marks.

Compaction is the most important stage of construction: it provides density, strength, smoothness, and surface texture. Compaction begins immediately after placement with a vibratory steel-wheel roller and continues until the pavement meets density requirements. A pneumatic tire roller is then used to smooth any rough areas and provide a smooth surface texture. For appearances, joints are sawed into the RCC to control crack locations. The concrete is then cured with a fine mist of water and covered with plastic sheets.

Roller Compacted Concrete is usually compacted to 95% of the maximum dry density. The interaction of the major components of RCC causes this to occur. The low water content of the concrete allows it to support the weight of the equipment used to place
and compact the RCC material. However, the water content needs to be high enough to insure that the concrete paste can migrate throughout the aggregate to fill the voids.

The high level of compaction achieved by RCC can cause problems. The mix is susceptible to freeze-thaw damage since it is denser than plain concrete. A balance needs to be maintained between compaction and air entrainment, which helps prevent the freeze-thaw cycle. Therefore, proper drainage is more important for Roller Compacted Concrete than other types of Portland Cement.

Joint construction is the most critical component of Roller Compacted Concrete pavements. The joint between adjacent lanes is considered fresh if the second lane is placed before the first lane has set (usually one hour). For fresh joints, the last 12 to 18 inches of the first lane are left uncompacted and the adjoining lane is laid down. The roller compacts the last bit of the first lane with the start of the second lane. The joint will require more passes of the vibratory roller to reach the desired compaction but the two lanes can be considered a monolithic slab when the pavement is finished.

Cold joints are formed when the first lane has set before the second lane can be laid. To construct a cold joint the outside uncompacted edge of the first lane is trimmed away and the new lane is laid butting up to the older pavement. Fresh material that is left on top of the hardened material during compaction usually causes raveling or spalling. Therefore, any overlap of the fresh concrete onto the hardened lane should be pushed before compacting the new lane.

Transverse expansion joints are placed at 30 to 70 foot spacing. These joints are typically cut with a concrete saw to a depth equal to ¼ to 1/3 of the pavement thickness within 48 hours of RCC placement. The joint is then back filled with a flexible material such as urethane.

The best indicator of the quality of Roller Compacted Concrete is to observe the concrete’s behavior under the static roller passes. RCC that is too wet for compaction will appear pasty or shiny and will exhibit pumping behavior even under foot traffic. Mix that is too dry will appear dusty and may shear horizontally under the roller.

Moist curing is usually used for RCC due to its low initial water content. Curing ensures a strong and durable pavement. As with any type of concrete, curing makes moisture available for hydration—the chemical reaction that causes concrete to harden and gain
strength. A water cure sprays or irrigates the pavement to keep it moist. A spray-on membrane can also be used to seal moisture inside. The surface should be kept moist for a minimum of 7 days. The roadway is usually opened to traffic after curing for 14 days. An asphalt surface is sometimes applied for greater smoothness or as a riding surface for high-speed traffic.

**RCC MIX DESIGN**

The primary components of Roller Compacted Concrete are the same as conventional concrete pavement – aggregate, Portland cement, water and Class “F” or “C” flyash. The roller compacted materials are combined differently from conventional concrete resulting in a unique pavement that provides savings over standard concrete pavements.

The aggregate mix for RCC is a well-graded material that permits a high compaction rate. The fines (particles that can pass a No. 200 sieve) are included to help fill voids between larger aggregates and should not exceed 14% of the total aggregate. The fines need to be non-plastic and the amount will affect the fresh and hardened properties of Roller Compacted Concrete. The largest aggregate used in RCC is usually ¾ inches in diameter. This allows the concrete to have a relatively smooth pavement surface texture and helps prevent aggregate segregation. A nominal maximum size aggregate (NMSA) of 5/8 inches may be used if a smoother surface is required. The NMSA used can be increased to 1-1/2 inches in the lower lifts if more than one lift is used in the construction of the pavement.

Coarse aggregates consist of crushed or uncrushed gravel or crushed stone while the fine aggregates consist of natural sand, manufactured sand, or a combination of the two. Crushed aggregates typically work better in RCC mixes due to the sharp interlocking edges of the particles, which help to reduce segregation, provide higher strengths, and better aggregate interlock at joints and cracks. Since approximately 80 percent of the volume of a high-quality RCC mix is comprised of coarse and fine aggregates, they should be evaluated as to their durability through standard physical property testing such as those outlined in ASTM C 33.
The cement content of RCC pavements is 100 to 600 pounds per cubic yard and is usually Type I or Type II Portland cement. Fly ash, which typically constitutes between 15 and 20 percent by weight of the cement material, is also added to RCC to supply additional fines to fill the aggregate voids.

**Engineering Properties**
The engineering properties of Roller Compacted Concrete are comparable to normal weight concrete.

- Compressive strengths of 4,000 to 10,000 psi
- Flexural strengths of 500 to 1,000 psi
- Modulus of elasticity is between 3,000,000 and 5,500,000 psi
- Mixture
  - Not air-entrained
  - Lower water content
  - Lower paste content
  - Larger fine aggregate content
- Generally designed as plain, un-doweled, unreinforced concrete pavement

In 1985, Tayabji and Okamoto published the result of a study investigating the compressive strength, flexural strength, split tensile strength, modulus of elasticity, and fatigue behavior of Roller Compacted Concrete. The RCC test results were consistent with tests conducted on typical concrete paving.

**Test Results**
(28 days after construction)

<table>
<thead>
<tr>
<th>Test</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexural Strength</td>
<td>480 to 670 psi</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>3720 to 4440 psi</td>
</tr>
<tr>
<td>Modulus of Elasticity</td>
<td>4,700,000 to 5,020,000 psi</td>
</tr>
</tbody>
</table>

The resulting design curve for fatigue stress ratio was slightly lower than the PCA curve for conventional concrete. Tayabji and Okamoto concluded that thickness design methods for concrete paving is also applicable to RCC pavements when used with the RCC fatigue curve.
Tayabji teamed up with Halpenny to develop figures and tables for use in designing Roller Compacted Concrete pavement. The design principles and assumptions used were the same as those used for designing typical concrete pavements with one major difference – only interior load placements were considered critical for pavement thickness. Design considerations were limited due to the low speed, multi-directional traffic at off-highway facilities and industrial driveways, which minimizes faulting and pumping problems.

Load transfer at joints directly affects the design stress and thickness of pavement. Roller Compacted Concrete cracks naturally with regular spacings from 40 to 70 feet apart. Research has shown average load transfer values at transverse contraction cracks of approximately 19% and longitudinal crack values of 17%. Test values on construction joints showed even lower values for load transfer. Therefore, the best method is to base the thickness design of RCC on no load transfer at the joints.

Design varies based on subgrade (k value), flexural strength, elastic modulus, loading, and other factors

**ACI Gradation Limits**

The American Concrete Institute (ACI) has established aggregate gradation limits that have produced quality RCC pavement mixtures. These ACI gradation limits effectively allow the use of blends of standard size stone, most commonly #67’s, #7’s, #8’s, and #89’s, along with sand, to be used in RCC pavement mixes.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Inch</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>19.000</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>12.500</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>9.500</td>
</tr>
<tr>
<td>#4</td>
<td>4.750</td>
</tr>
<tr>
<td>#8</td>
<td>2.360</td>
</tr>
<tr>
<td>#16</td>
<td>1.180</td>
</tr>
<tr>
<td>#30</td>
<td>0.600</td>
</tr>
</tbody>
</table>
Both ACI and the Portland Cement Association (PCA) recommend the use of dense, well-graded blends with a nominal maximum size aggregate not to exceed $\frac{3}{4}$-inch (19 mm) in order to help minimize segregation and produce a smooth finished surface. Gap-graded mixes that are dominated by two or three aggregate sizes are not desirable for RCC. Additionally, the recommended gradation calls for a content of fine particles (2% to 8% passing the #200 (75 µm) sieve) that is typically higher than that of conventional concrete. This eliminates the need for washed aggregates in many cases and produces a mix that is stable during rolling.

In cases where washed aggregates are being used, it may be difficult to meet the specification for 2% to 8% fine particles. In cases like this, fly ash can be added to the mix to provide the desired fines content. These fines provide lubrication that helps to distribute the paste throughout the mix. However, these fines need to be non-plastic with their Plasticity Index (PI) not to exceed 4.

In many cases, aggregates used in typical highway construction will also meet the RCC gradation requirements mentioned above. Graded aggregate base material, crusher run material, and aggregates for Hot-Mix Asphalt (HMA) paving mixes can be used with little or no modification in RCC mixes.

**Tennessee Dept. of Transportation (TDOT) RCC Specifications**

**Materials:**
- Portland Cement ASTM C-150, Type 1
- Aggregates ASTM C-33
- Fly Ash AST, C-618
- Water – Potable

**Mix:**
- 250 lbs. Type 1 Portland Cement or 300 lbs. Type 1 Portland Cement
- 100 lbs. Class “C” Fly Ash or 125 Class “F” Fly Ash
- Course and fine aggregate according to ACI 211
Water cement ratio 0.28 to 0.33. Slump not to exceed 0

Mixing: RCC can be mixed in either Pug Mill, Central Mix Concrete Plant, or a Dry Mix Concrete Plant using transit mixers to mix the RCC. Transporting to job site shall be in tandem dump trucks.

Control: Core shall be evaluated as per ACI-318. Concrete shall meet a compressive strength of 3,000 psi at 90 days

Sample Projects

Roller Compacted Concrete is extremely popular with automakers due to its low cost, speedy construction, high strength, and low maintenance.

Saturn Corporation – Spring Hill, Tennessee
Built: 1988
One of the largest RCC projects to date – used 650,000 square yards

- Virtually no maintenance costs
- Excellent condition

State Route 27 - Chattanooga, Tennessee
Turn/Storage Lane
Built: 1998

This was a small paving project requiring 441 cubic yards of Roller Compacted Concrete. The concrete was mixed in a dry batch plant located approximately 18 miles from the job site. The mix was delivered to the site by 12 dump trucks. The RCC was placed using a standard asphalt-paving machine. The mix was compacted as it was laid. This required fewer passes of the vibratory roller and produced a sufficient surface and ride quality without an asphalt overlay. This project was built with a 6-man crew in one day, cured with white pigmented curing compound, and opened for road traffic the next day. The finished Roller Compacted Concrete reached a compressive strength of
over 4000 psi in 3 days. The project cost was $29,000 –approximately $5000 less than the estimated cost for conventional asphalt pavement.

**Honda Manufacturing of America – Lincoln, Alabama**
Automotive Plant
Built: 2000 – 2004

This site has been considered to be the largest Roller Compacted Concrete project (4-inch and 8-inch layers) in U.S. history with over 1 million cubic yards (approximately 61 acres) of 5” and 7” RCC paving. A high-speed (250 cubic yard/hour) Aran continuous-mixing concrete plant was set up near the job site. The mix was delivered by dump truck to a paver equipped with a vibrating screed and dual tamping bars. This allowed the RCC to be laid with a 90 – 95% density directly from the paver. The paving was saw cut after compaction on 30-foot centers to prevent natural cracking. The cuts were then filled with a urethane joint compound. The project was also cured with white concrete curing compound to seal the RCC. The finished product reached a compressive strength of 5000 psi, and a flexural strength of 1000 in 7 days. The initial cost for RCC was estimated as equal to asphalt paving, but Roller Compacted Concrete was the less expensive alternative after considering life cycle expenses.

**Volkswagen – Chattanooga, Tennessee**
Automotive Plant
Built: 2010

This placement of 4-inch Roller Compacted Concrete is the largest scale placement (over 500,000 square yards) of this thickness in the U.S. The subbase for the RCC was either graded aggregate or cement-stabilized soil depending on in-situ soil conditions. In addition to the plant site, the access roads used 9 inches of RCC with a 4.5 inch asphalt surface.
LIMITATIONS

While this brand of concrete is an excellent performer, it does not provide all the features and benefits of regular concrete. These differences are not a factor in the types of applications RCC is used for.

- **Aesthetics** - RCC does not have the same appearance as other types of concrete. It is not as pretty and smooth as regular concrete.
- **Rougher surface texture** - The mix design and construction methods that make roller compacted concrete so fast, easy, cheap, and durable also create a surface texture that gives it a characteristic coarse finish.
- **Limited to low-speed traffic** - Due to the nature of its surface, RCC is not appropriate for all types of traffic. Vehicles traveling at high speeds would experience a bumpy ride. That makes it better for applications where strength and durability are needed instead of speed.

Roller Compacted Concrete needs to be monitored for aggregate separation and the rapid set time of the material during the construction phase. When using RCC on city streets, susceptibility to freeze-thaw cycles and low joint transfer are known problem areas.

SUMMARY & CONCLUSIONS

Roller Compacted Concrete provides a low-cost pavement with the strength to withstand heavy loads and durability to resist rutting. RCC has been in used for this type of application for over 30 years. These pavements do not deteriorate from spills of fuels and hydraulic fluids and it does not soften under high temperatures. The makeup, installation and engineering properties of the material are well understood. RCC pavements are the choice for economy and performance in low speed, heavy vehicle traffic environments.
RCC has had past problems with susceptibility to freeze-thaw cycles and low joint transfer capabilities. Special attention is required for possible aggregate separation and quick set time of material during construction. Roller Compacted Concrete should not be a paving alternative for State routes or other high-speed facilities. More research needs to be conducted in the areas of: corner loading; ways to improve load transfers at pavement joints; and the effect of environmental exposure on pavement durability.

**RECOMMENDATIONS**

Roller Compacted Concrete has been designed for a wide range of performance conditions, from low-strength more massive structures to high-strength less massive structures. It is critical that the design of the structure be coordinated with the performance requirements for the RCC material and the specification requirements for construction.

RCC was initially developed to produce a material exhibiting the structural properties of concrete with the placing characteristics of embankment materials. The result was a material that, when properly designed and constructed as a gravity structure, should be more economical than comparable earth-rockfill and conventional concrete structures.

**Thickness Design**

The Portland Cement Association method for RCC thickness design requires the following information:

1. **Supporting strength of the subgrade or subbase-subgrade combination**
2. **Vehicle characteristics**
   - wheel loads
   - wheel spacing
   - tire characteristics
   - number of load repetitions expected during design life on different areas of the pavement
3. Flexural strength of RCC
4. Modulus of elasticity of RCC

The Army Corps of Engineers also makes the following recommendations:

- Maximum lift thickness of 10 inches
- For multi-lift pavements – the upper lift should be a third of the total pavement thickness (no less than 4 inches)
- No load transfer at the joints – assume all joints/cracks to be free edge condition

To achieve the highest measure of cost effectiveness and a high-quality product similar to that expected of conventional concrete structures, these RCC design and construction objectives are recommended:

- RCC should be placed as quickly as possible;
- Operations should include as little manpower as possible;
- Design should avoid, as much as possible, multiple RCC mixtures and other construction or forming requirements that tend to interfere with RCC production;
- Minimize complex construction procedures

Roller Compacted Concrete has proved itself a viable alternative in low speed, heavy vehicle traffic situations. RCC pavements have been in use for this type of application for over 30 years. The content, installation, and engineering properties of the materials are well understood. Many different cities are using RCC where the advantages of ease of installation and durability make it an attractive alternative.
Figure 12-1. Design Curves for Plain Concrete Roads and Streets, and RCCP.

(Ref: U.S. Army Corps of Engineers)
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