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READY MIXED CONCRETE [1]

by

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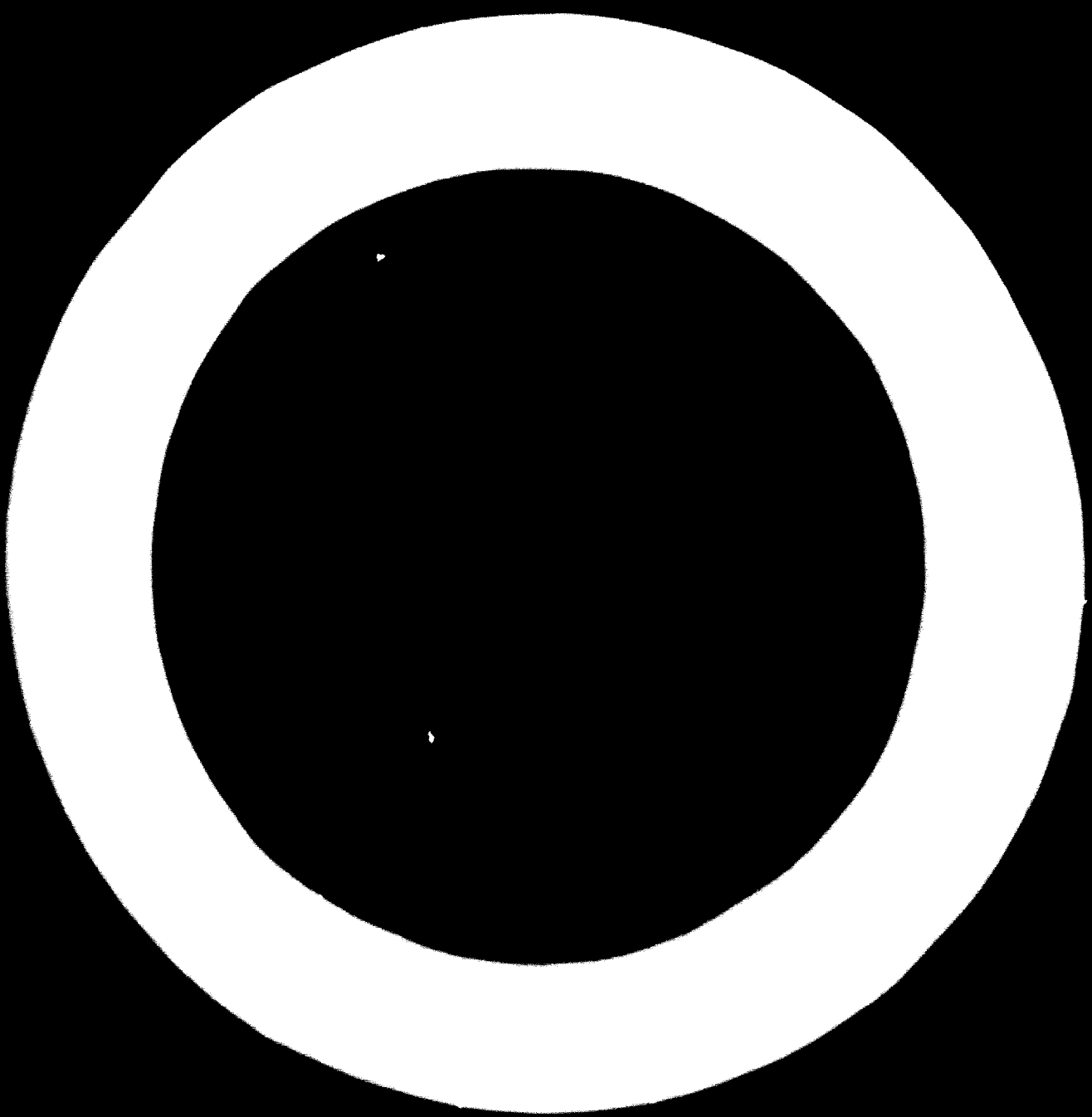

Most of the things I am going to tell you are, of course, based on the methods and systems of my own firm. In outline, this will apply to every production of ready-mixed concrete, but in detail it can be changed in many different ways, dependent on economy, geography, etc.

Let us take a look at the structure and the organizing system of my firm. My own position is the management of the daily production and working with reference to the managing director. - We produce and deliver ready-mixed concrete to building sites in all sizes in the area of Copenhagen and in the area of 4 adjoining provincial towns. Our customers are mainly contractors, both within house building as well as public works, e.g. bridges, tunnels, etc.

For the production we have 12 concrete factories:

4 in the centre of Copenhagen
3 in the suburbs, and
5 near to the surrounding towns

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For the transport of the concrete we have about 130 cars of different sizes and constructions at out disposal. Regarding the cars we will go into details later in this lecture.

Our production in 1971 was about 680,000 m^3.

In the main, our organization is built up in the way that each factory works as in independent unit, but under a common management and administration.

To manage the factories these are gathered in regions under one works manager, who is responsible for the running of 3 factories. In each factory there is one foreman and one clerk together with 2-6 workers, according to the size of the factory. The smallest factory has an annual production of 20,000 m^3, and the annual production of the biggest factory is 120,000 m^3.

The factories themselves take care of the daily purchases of raw materials and other supplies from suppliers with whom we have regular contact. All orders for concrete will be received at our head office, where they will be planned and distributed between the plants in the economically most favourable way, so that the capacity of the plants will be used in the best way.

Basically, the purpose in production of ready-mixed concrete is: To deliver concrete to building sites, ready to pour into the construction. This is done - still basically - in 2 different ways: Central-mixing and transit-mixing. In central-mixing you pour the mixed and finished concrete into the vehicle. In transit-mixing you pour the raw materials into the vehicle, which is a mixer, and then - along the way to the building site - water is added and mixing of the concrete is completed. In Scandinavian countries there is a preference for central-mixing. The main objection to transit-mixing lies in the greater power consumption needed on the

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vehicles and most of all the lack of quality control of the concrete. You can only be sure of the quality of the concrete delivered if you know exactly how much of each component there is in the ready-mixed concrete, and in transit-mixing you know nothing of the quantity of the water, which is of the greatest importance. The official standards for concrete in the Scandinavian countries are so strict that in fact they make transit-mixing impossible.

The cost of a central-mixing plant is greater than that of a batching plant, but this is claimed to be offset by the lower cost of agitator trucks and the fact that the pay-load of a vehicle with a mixer and a watertank is about 20% less than an agitator-truck for a central-mixing system.

A factory for ready-mixed concrete can be carried out in 1000 different ways. Unfortunately, we are pressed for time, but I have taken out two main types to illustrate two typical basic principles, the high and the low factory.

Let us start with the low factory:

This type has the advantage of being comparatively cheap to build up. It has a rather big stock of materials ready for use. The materials are divided into fractions in a so-called starshaped stock, and sunk under ground in the middle of the star the weigh-bucket is placed. Small remote-controlled conveyor belts bring sand and gravel to the weigh-bucket, and from there the material is carried directly to the mixing plant by a bigger conveyor belt. Cement and water will be weighed out by the mixing plant - all led by a starting-platform above the mixing plant.

In the starshaped stock a radial scraper brings gravel and sand into the middle of the star. We use this type of factory for plants to produce up to about 60,000 m^3 per year. This type can, of course, be built both small and big. Two men are required all the time, and the plant with open stocks

of sand and gravel is very vulnerable to the influence of the climate, especially in the winter time, where snow and frost cause difficulties.

If we are to produce more than 60,000 m^3 per year, the best solution is a "tower factory", or - as we call it - a "high-factory".

Here - once for all - all the raw materials are taken up to a stock in the top of the tower, and afterwards we utilize the pull of gravity in the production.

The tower is constructed as a cylinder on end, and sand and gravel are led to the top, either by crane, by bucket elevator or by conveyor belts.

In the top the material will be led into different rooms by a turning-shoot, and we have now a stock ready for use.

Just below the stock the weighing-floor is placed, where all the raw materials - sand, gravel, cement and water - are weighed before emptying to the mixing plant. The tower can be fitted up with one or several mixing plants. In this way a high capacity can be obtained, and you will surely understand that sand and gravel are most protected in the tower. In the wintertime we have the possibility of preheating all materials, so that even in a severe frost - we have a great capacity of warm concrete. At the bottom of the tower, the boiler room and compressor are placed, because all our automatics are worked by compressed air.

For the distribution of the concrete we have about 130 cars of 3 different main types.

The most simple is the "tub car" - the so-called "sauseboat" or the bathtub". The concrete is transported in an open tub, which can be tipped backwards by emptying. The "tub car" is the most inexpensive solution, simple to maintain and clean, and in quiet periods it can be used to transport other materials, but, however, at long distances and when transporting lean concre

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the concrete may separate, and it may also be damaged by the sun, rain, or snow.

The second type is constructed by the founder of our firm, Mr. K. Hindhede, and has been in active service for nearly 50 years.

It is suitable for all kinds of concrete, both wet and dry, rich and lean, has a rather big pay-load, and is rather dependable.

Unfortunately, it has two drawbacks:

It unloads in a very low height, about 90 cm above the ground, and it cannot transport anymore than 2,75 m^3 at a time.

The third type is the big three-shafted high-discharge, which we aim at more and more year by year. Here in Denmark it can transport up to 5 m^3 at a time, unloads the concrete quite homogeneous in the drum by means of a worm. By unloading the concrete the direction of rotation will be changed, and the concrete will be "pushed" out. It is a very good car, but rather expensive, about 200,000 D.Kr.

It has the drawback that it cannot load or unload the dry concretes, and it is difficult to keep clean too. Its pay-load is also smaller than types I and II.

In all our plants are stationed permanently a number of cars, owned by us. It is about 80 cars. The remaining 50 cars are leased by us and are daily distributed by the central administration between the plants, where the need is. In this way we have a high flexibility in the distribution.

As you know, it is of great importance by production of concrete that the ratio between the individual components is right, i.e. that the sieve curve is as correct as possible, that all sizes of particles are mixed in the concrete.

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It is easy to understand by taking a look at a picture of a wall:

Here, you will find that the cavities between the big grains are filled up with grains of small sizes, and that the small cavities are filled up with grains of smaller sizes, and that the smallest cavities are filled up with cement. This results in a very compact concrete, which can be proof against climatic conditions and protect the steel reinforcements. To secure this condition in the best way, we always produce concrete with sand and with at least two different fractions of gravels. Each component will be weighed separately. Therefore, it is of great importance that our scales weigh exact, and are maintained in the best possible way.

At least once a week we weigh a load of concrete to make certain that the total weight of the load is corresponding to the sum of the quantities weighed out.

Besides, twice a year, we go through the whole weight system carefully and check-weigh the whole system of scales with plumbs.

At the same time we keep a very careful material account to make sure that the consumption of materials, especially cement, corresponds to the lots of concrete delivered.

It is also very important to estimate the moisture of the sand all the day, because a changing moisture content may have the result that we do not weigh out the correct quantity of sand, if no alteration takes place.

In our newest and most modern factory at Hedehusene, which you are going to see on Saturday, the whole weighing is controlled by a computer, programmed with the correct quantities for 1 m^3 of the most ordinary sorts of standard concrete, and the computer remembers the programmed water-cement ratio and corrects for water and sand.

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Not only do we want to deliver a correct quality, but also a correct quantity. Therefore, it is of great importance to keep a sharp watch on our dosing equipment.

As it is very difficult on a building site to control that the correct quantum is delivered, it is a matter of confidence between our customers and us, and we have to secure ourselves in the best way against mistakes.

Not only to secure a good quality, but also to secure a good economy in the production is it necessary to keep an extensive quality control. Our concrete control is based on a control of raw materials and control of the finished product, both in fresh and hardened conditions.

The quality of the cement in Denmark is so good that the control is just a matter of routine. However, the control of sand and gravel is necessary because of the very different qualities. Every day each factory takes out samples to be sifted. Afterwards the grain curve is drawn, the content of clay and slurry is measured, and frost-dangerous grains are measured, too.

If the quality becomes poorer, the supplier will be advised, and if he cannot be of assistance to us, we get another supplier.

We control the concrete by taking out a spot test from the production. 3, 4, 5, or 6 times a day a sample of the fresh concrete is taken out.

Following measurings are made:

Slump; entrained air; unit weight; temperature; water-cement ratio, and 2 specimens. The specimens are cylinders of 15 x 30 cm, according to Danish standards, kept under water (20^{o}) for 10 days. Then they are kept in dry air until they are 28 days old and then crushed. The result, expressed in kilograms per square centimetre is put into our statistics. Our central laboratory surveys the different concrete controls of the plants,

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and the central laboratory itself runs a parallel control, based on samples, taken out by mobile laboratories at the building sites.

We use statistical quality control, in the main based on 2 sorts of ordinary standard concrete as parameters, not only to secrue a good enough quality, but also to secure a good economy in the production.

It is not hard to produce good and strong concrete. - <u>The problem is to produce it good and strong - and with expenses reduced to a minimum.</u>

If we are to start up a concrete factory, one of the biggest problems very often is: WHERE?

1. Is it to be placed where the market and the sale is (to get short distances)?

2. Is it to be placed near a port or a gravel-pit (to get accessible raw materials)?

I am not able to answer this question. It depends on financial consideration in each singl case, and I may add that we have used both solutions.

It seems to me that an unrestricted access to the raw materials is the best solution.

After this, the problem is almost eliminated, and we may concentrate on another problem, which is for us one of the biggest: The distribution of the concrete. We find it very difficult to adapt the speed and the quantity of the delivery to 20-50 different building sites from one plant on one day to the capacity of the plant, to avoid both idle running for plants and periods of waiting for cars.

There is a lot of money in the solution of this problem. We try to solve it in the best possible way, because we cannot solve it completely.

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A superior mixing capacity and a quick service are necessary. Steady drivers with a constant speed, which we can trust, are necessary too, but anyhow, much depend on the building sites.

For many years we have done very much to obtain the best possible contact with the building sites and to prepare them for the reception and use of ready-mixed concrete. To handle this problem we have a staff of 4-5 inspectors, who have the job of being contact-men between the plant and the building sites. They are to secure that the factory is informed in the best way about the situation at the building-sites, and that the traffic conditions are good enough. They are to secure that delivery takes place with a speed that is suitable for the building site, and in a quality which fits the constructions. They are to plan orders in advance, so that actual delivery takes place as easy as possible. To improve the contact to the building sites further, most of our cars are supplied with radio, so that problems and alterations may be made by radio.

For permanent building sites we have out hydraulic lly lifted bunkers for reception of ready-mixed concrete, so that the car may deliver the load quickly and get away for another load. In the meantime the men at the site pour the concrete into the construction by means of crane or barrow.

In recent years we have delivered the concrete, pumped into the construction with special concrete pumps. This way of delivery has become very popular, since it reduces the work of the staff at the actual site to a minimum. At the same time it has a big pouring-capacity.

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I have now tried to give you a brief view into the world of ready-mixed concrete, and I hope it has satisfied you a little. Next Saturday you are going to visit one of our plants and I will be looking forward to it. Perhaps we can then go more into detail in some of the problems, if you are interested. Now, here, we still have some time left, if you have questions, if there is something you did not quite understand, and I will try to answer the best I can. I know that you are very interested in one thing of course: MONEY. And therefore I will mention some of the most important prices:

Plants:

Big plants for 100,000 m^3/year	D.Kr.	6,000,000
Smaller plants for 30,000 m^3/year	D.Kr.	500,000

Vehicles:

5.0 m^3 Volvo	D.Kr.	210,000
5.75 m^3 Volvo, KH-agitator	D.Kr.	120,000
3.0 m^3 Volvo	D.Kr.	110,000
Maintenance per year ..... about	D.Kr.	15,000

for a period of a lifetime of 5-7 years

Price (Sales-Price) for Concrete:

Free delivered within 5 km:

Standard for foundation	D.Kr.	110.00/m^3
Standard for reinforced concrete	D.Kr.	150.00/m^3


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