"MORE THAN ONE CLAIM TO FAME"

REMARKS ON THE CN TOWER

by

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to the

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at the

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The opportunity to speak to you today about the world's tallest structure is very much appreciated because it gives me a chance to perhaps clarify some misconceptions about the CN Tower and to hopefully illustrate to you why a visit to Toronto's newest attraction will be an exciting experience.

Imagine a Crown Corporation undertaking an innovative, useful, profitable Tower. Few people realize that CN operated the first diesel-powered train in North America, started the use of radio-telephonic communication from a moving train, developed the first weigh scale capable of weighing rail cars with uncanny accuracy and began a radio broadcasting network. It is, therefore, not surprising that CN had the foresight to build this incredible structure.

On the face of it, it may seem as if the CN Tower combines only the same old cliches present at most other towers, i.e. revolving restaurant, indoor and outdoor observation decks, souvenir shops, and the like. However, one must look closer at each of these elements to see how different it really is.

Initially, the prime reason for the Tower's being,

communications is still the essential function of the Tower and is what principally gives it its form. Its height is based on the concept of stacking television over FM antenna on a single 330' mast. This group of antennas must be separated 350' vertically from the microwave dishes below at the 1100' level. Microwave, or point to point communications, should, of course, be high enough to clear all existing and planned obstacles. During the early planning this was determined to require an 1100' elevation. All of these communications functions combined resulted in a structure 1780' high. A look at the record books indicated a height just over 1800 feet would be sensible, much to the delight of Ross McWhirter of the Guinness World Book of Records.

In concept the structure is a 1500' post-tensioned concrete cantilever topped by this 330' steel mast. The concrete structure consists of a vertical 6-sided form braced by 3 tapering wings which disappear at 1100'. A seven storey steel and concrete sky pod is attached to the main shaft between the 1100 and 1200 foot levels.

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This concept departs from the traditional tapering concrete tube in order to realize two important design objectives. First to create vertical shafts on the outside so that the vertical transportation systems could be exposed and secondly to provide vertical surfaces on which to run utilities and broadcasters' cables. Most other towers have had to construct a vertical steel frame within their tapering concrete cylinders to support elevator rails, stairs, and other services.

When it came to supporting the seven storey sky pod it was also possible to depart from the traditional mushroom or saucer form used typically on many other European towers. The 6 corners of the CN Tower's hexagon could support enormous concrete "brackets" and with the addition of an internal concrete ring at their base and another at their perimeter, six more brackets could be added in the centre of each wall. This support structure permits for the first time, the feature we wished to capitalize on of allowing unique views for the public directly down the faces of the tower shaft.

The tower foundation structure is founded on Dundas Shale (Ordovician Age) which lies some thirty feet below

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the ground level. It penetrates some 20' into the rock and is about 20' thick. The final excavation was carefully done by hand and immediately covered with a base or bearing slab of concrete, the rock never being allowed to dry out. The foundation is shaped like the hull of a ship, its top part projecting above its base thus offering great resistance to shearing of the rock. Actually, it appears ridiculously inadequate on a sectional drawing of the tower, but is nontheless such a rigid component that it would carry the entire mass of the tower on its rim before overturning. (This would require a wind force of almost 300 mph). The foundation is not anchored to the rock in any way since the rock anchors would not last as long as the projected life of the tower which is around 300 years.

The post-tensioned concrete shaft was slipformed over an 8 month period ending in February 1974. All of the Tower walls have hundreds of steel cables in them which, when stressed, place them in permanent compression and will remain that way even on the windward side under the severest load. This ensures that they will be crack-free and, therefore, the steel within them protected from chemical action of the atmosphere. The team work required for this slipform operation was the smoothest I have ever witnessed on any project. The leaders of this team were our

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Director Mal Grant, Structural Engineers Franz Knoll and Frank Tam, Project Architect Ned Baldwin and Foundation Co.'s Manager Andre Jordan. Continuous finger-biting meetings among these men were the order of the day.

The resultant post-tensioned shaft is also an extremely rigid structure. In fact, we predict a deflection of less than 2 feet at the 1500' level if we get a 130 mph gust of wind. This will not even produce a ripple in the contents of your wine glass in the restaurant below.

The 330' steel antenna mast sits on top of the concrete structure attached by 150 bolts penetrating 11' into the concrete. You all remember Olga who last spring gently lifted 39 sections into place which are connected by 40,000 bolts. Conventional placement procedures would have required nearly 5 months for the same work that Olga did in 22 days.

Few people realize that this antenna structure requires dampening devices to reduce dynamic response to turbulent winds. Even the builders of gothic cathedrals employed heavy chains hanging within their steeples to soften the motion which otherwise might develop.

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In our case the antenna mast had to have its motion dampened by some means to prevent excessive deflections. Heavy chains could not be used due to the restricted space. Steel box beam rings filled with 10 tons of lead were developed to circle the mast at two elevations. These were supported on pendula allowing the entire ring to shift horizontally approximately two feet. Three spring boxes with enormous shock absorbers prevent them travelling further and provide a "restoring" force which dampens occilations of the whole steel structure. Engineering these mechanical devices to be fail safe and maintenance free over the life of this structure has been a tremendous feat. Fitting them in the confined space available, along with strobe beacons, flood lights, and other systems present at these areas, has also been a challenge for our designers, engineers and contractors.

Toronto's highly competitive broadcasters all quickly realized the tremendous value of the CN Tower and the need to co-operate on their antenna installations. Thus a consortium of broadcast tenants was born, including CN Tower's interest in future antenna space. We contracted with EMI Sound and Vision Equipment Limited of England for the installation of antennas, feedlines, transmitters and a radome covering at the top with the broadcast equipment on levels 5 and 6 of the sky pod. All 5 existing FM stations (CHIN-FM,

CHUM-FM, CHFI-FM, CKFM-FM and CBL-FM) as well as space for 6 future unassigned FM frequencies, are accommodated at the base of the mast. These are topped by the TV channels 5 and 25 of the CBC, channel 9 of CFTO, 19 of CICA and 79 of CITY, with space for future UHF channels 51, 55 and 57.

Packing all this equipment on to the single mast and accommodating all feedlines (which range up to 6 inches in diameter and require enormous bending radii) is no mean feat of co-ordination. Detailed layout drawings have been done at every point and still inevitable adjustments are taking place in the field. The 5 television channels are expected to be on air very early in the new year with the 5 FM stations to follow on air about a month later. The broadcasters will decide more exact dates before Christmas.

Land Mobile communications facilities, the broadcasters studio transmission links and microwave dishes including CN-CP Telecommunications requirements will be placed primarily within the microwave level, or level 1 of the sky pod.

This microwave is perhaps the most exciting

broadcast installation because of its shielded radio space and its air supported radome. The 25 foot high section allows ample room in its interior for installation of the microwave dishes which range up to 15' in diameter. The fabric used is a teflon coated fibreglass material which is so thin that it has negligible effect on the short wave length signals which must pass through it. In contrast, the FM/TV antenna radome at the top of the Tower is 2" thick as these signals have much longer wave lengths.

Another problem in this air structure is getting large antennas into it after it is inflated since it is kept inflated under pressure. For this purpose, our engineers and architects have developed a continuous ring of trap doors beneath the radome. The special high volume - low pressure blower system will permit trap doors to be opened allowing dishes to be hoisted directly from a ground level to their final position without deflating the radome. All in all the microwave installation is the most sophisticated in the world and will allow its tenants unprecedented ease in servicing their equipment and keeping it free of ice.

The CN Tower will receive hundreds of lightning strikes every year. To conduct these safely to the

ground, copper straps were fastened to the internal walls on the surface where they can be periodically inspected. All Tower elements are bonded at periodic intervals to these copper down-conductors. Still somewhat a black magic area of science, lightning theory abounds with conflicting opinions amongst its experts. We had no choice but to adopt the most conservative of all views to solve this problem.

The problems of how to externally light the Tower involved an intriguing mixture of problems associated with aircraft, aesthetics and song birds.

All tall structures have a problem with migrating birds in the Spring and Fall. Tall smoke stacks illuminated at night by ground level searchlights to make them obvious to pilots, have killed literally thousands of birds on a single night. Small song birds particularly, fly at high elevations, with the greatest concentration being around 1,500' to 1,800'. Since the CN Tower was to penetrate this air space for the first time, it was felt by some environmental groups that the Tower would pose a problem. We

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retained a noted ornithologist to advise us how to minimize this hazard and were advised that lighting was the key to the problems.

Since the Tower as a physical obstacle would intercept the flight paths of very few birds because of its slender profile, the problem was how to minimize the stray light which was allowed to escape into the sky,and yet meet the requirements of adequately lighting the Tower as an obstruction to aircraft.

M.O.T. Standards clearly spelled out what their minimum requirements would be. Red flashing lights at 200' intervals and five tiers of white flashing strobe lights with an intensity of 2,000 candles at night) were specified. In the daytime, these strobes flash at 200,000 candle power. We felt that additional

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lighting was required beyond this and as a minimum, the form of the tower must be discernable, certainly during the early evening when people are about.

Obviously floodlighting from the ground was unsatisfactory. A scheme was initially developed utilizing narrow beam quartz lamps shining horizontally away from the elevator shafts to softly illuminate the Tower legs. Unfortunately, this scheme was scrapped due to capital and operating cost projections.

It has been replaced by a series of small low level direct sources to form a "string of pearls" effect rather than attempting to light the wing walls. These will have to be turned off during bird migration periods under certain climatic conditions but for the rest of the time will effectively link the illuminated upper structures with the ground visually at night. The upper structures including the concrete shaft and the antenna radome are to be illuminated using carefully controlled narrow beam quartz lamps to eliminate stray light into the night sky.

Bird kills at the Tower during construction have been extremely minimal and I believe when the final lighting is in place they will be virtually non-existent.

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Finally, the Tower's role as a tourist attraction is the most important function from an economic viewpoint. To be self-supporting financially, as well as structurally, required that this aspect be built into it.

Some of our ideas are based on visits to several other towers and attractions in Europe and North America.

The 420 seat restaurant is first of all to be a fine dining room on its own, quite independant of its location, and our architects are shaping its interior with great attention to detail. The result will be an excellent place to have dinner where one will be quite unaware of the many visitors passing through the observation decks immediately below.

Large elevator capacity at the CN Tower (over 2,000 persons per hour) make it possible to dedicate one or more elevators exclusively to the restaurant.

For the most part, the view will be unsurpassed. On the few nights of poor visibility, a light show utilizing helium neon lasers will play on the clouds.

Soft lighting in the restaurant will permit one to

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see who one is eating with and to have conversation, rather than sitting in darkness as is so typical in most roof-top restaurants. The windows incline outwards thereby reflecting the dark ceiling rather than the battery powered lamps on each table.

A computerized reservation system at the pool level reception and cocktail lounge area at the base of the Tower will permit speedy assignment of tables.

The observation decks will contain a number of participatory displays, most notably its six zoom peri-telescopes. These are being designed and built in Ontario by a consortium of optical and mechanical designers including Ernst Leitz, the German lens and camera manufacturer. The excitement of operating a 20:1 ratio zoom from a stationary platform so high above its surroundings should alone bring people to the Tower. As one moves from 10X to 200X magnification one senses an apparent flight through the air at speeds in excess of 1 mile per second.

The telescopes will be operated by a playing card size ticket printed with a magnetic strip which will be erased gradually as one's credit is used. The ticket

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may be withdrawn at any time and the remaining credit used at another scope. A digital display will constantly read-out the credit remaining. This ticket switching arrangement could well be the forerunner for all such devices in the future. Needless to say these devices are patented.

Two mini-theatres are to be included where an 8 to 10 minute spectacular AV show will present the Tower under unusual weather conditions. Early morning views when cloud covers all other structures and the sun shines on the Tower will be especially exciting. This presentation will also show evidence of gale winds and lightning displays as seen from the very top of the Tower. It will culminate in a dramatic ascent from the base of the inner shaft through its entire length, continues up inside the antenna mast and out through the hatch on top into the sky. This footage is being filmed now utilizing the Wesscam camera mount which provides uncanny stability.

From the indoor observation level one will be able to board a fifth internal elevator and rise to the 1500' level where a small observation gallery featuring full height inclined windows will offer an unequalled view. This experience will have considerable mystery about it as one boards the elevator in semi-darkness within the core of

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the Tower (the only area in which the public enters this zone) and ascends for approximately 1 minute to an arrival level containing 3 porthole windows. These will give a hint of the spectacle which confronts you after climbing the short stairway to the upper observation level. Here the floor extends through openings in the concrete to form a circle. An all glass railing will hold one back from the sloped glazing but a certain amount of nerve will still be needed since the view includes the capability of looking straight down.

The base structure of the Tower will also contain some interesting attractions. Rear screen slide projections will explain the contents of the Tower to the visitor. Closed circuit cable TV displays will continuously present all channels. A digital display will indicate structural actions of the Tower as well as weather data. This program is sponsored by the NRC, and also involves Environment Canada and the U. of T.

In addition, a restaurant and an extensive merchandise area in which Canadian craft, and gift and souvenir merchandise, will be available. Our own licensed products will be included - we now have about 80 products under licence.

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These products will include Tower jewellery, post cards, models, various toys, decals and publications, for example. Some of these products are just now coming on the market and will be available in many stores outside of the Tower as well. This source of revenue is a reflection of our legally protected rights by national and international copyright, trademark and industrial law.

Most of these attractions and experiences are to be so unique that I have lost my concern about the CN Tower being a successful tourist attraction when it opens next Spring. This is because we decided early in our marketing plans that we needed to develop a specific philosophy prior to determining the attractions content, some of which I have just outlined. This philosophy is to provide a year-round educational entertainment experience that has a separate daytime and nighttime personality, and is unlike anything available in Canada today.

This has not been a tall story.

Thank you.