Claims

【Claim 1】

An apparatus for reducing a temperature difference generated in mass concrete made by assembling iron bars, setting up a form and pouring concrete into the form, during a curing process of the mass concrete, the apparatus comprising:

a main water reservoir adapted to store cooling water thereinto;

pipes disposed inside the form in such a manner as to be buried in the interior of the mass concrete at the time of concrete casting, the pipes being spaced apart from each other by a given distance in such a manner as to be passed through the mass concrete and being connected to the main water reservoir from which the cooling water is supplied thereto, so that the temperature of the interior of the mass concrete is decreased and the cooling water supplied thereto is heated to discharge heated cooling water therefrom;

hoses disposed on the outer surface of the mass concrete in such a manner as to be connected to the output ends of the pipes from which the heated cooling water is supplied thereto, each hose having a plurality of holes formed on the outer periphery thereof, through which the heated cooling water is discharged;

an auxiliary water reservoir adapted to store heated water thereinto;

supply pipes connected to the auxiliary water reservoir to supply the heated water to the outer surface of the mass concrete if the temperature of the interior of the mass concrete is less than a set temperature; and

a control unit operated to supply the cooling water from the main water reservoir to the pipes if the temperature of the interior of the mass concrete is more than a set temperature and to supply the heated water from the auxiliary water reservoir to the supply pipes if the temperature of the interior of the mass concrete is less than the set temperature,

the apparatus further comprising:–

switching valves mounted at positions where the output ends of the supply pipes are disposed between the pipes and the hoses to shut off the supply of the cooling water, while

supplying the heated water to the hoses through the supply pipes, if the temperature of the interior of the mass concrete is less than the set temperature,

further comprising: water recovery ducts disposed along the edges of the mass concrete so as to collect the heated cooling water or the heated water flowing along the outer surface of the mass concrete through the discharging from the plurality of holes of the hoses disposed on the outer surface of the mass concrete; and water recovery pipes connected to the water recovery ducts to collect the heated cooling water or the heated water to the main water reservoir,

alternatively, further comprising: water passages formed along the edges where the mass concrete and the ground meet each other to collect the heated cooling water or the heated water thereto; and water recovery pipes connected to the water passages to collect the heated cooling water or the heated water to the main water reservoir, and

alternatively, further comprising: water recovery pipes adapted to connect a position where the heated water or the heated cooling water gathers to the main water reservoir; and water recovery pumps provided to collect the heated water or the heated cooling water to the main water reservoir through the water recovery pipes,

further comprising:

first pumps disposed between the main water reservoir and the pipes to supply the cooling water to the pipes; and

second pumps disposed between the auxiliary water reservoir and the supply pipes to supply the heated water to the supply pipes.

【Claim 2】

The apparatus as defined in claim 1, further comprising switching valves mounted at positions where the output ends of the supply pipes are disposed between the pipes and the hoses to shut off the supply of the cooling water, while supplying the heated water to the hoses through the supply pipes, if the temperature of the interior of the mass concrete is less than the set temperature.

【Claim 3】

~~The apparatus as defined in claim 2, further comprising: so as to collect the heated cooling water or the heated water flowing along the outer surface of the mass concrete through the discharging from the plurality of holes of the hoses disposed on the outer surface of the mass concrete, water recovery ducts disposed along the edges of the mass concrete; and water recovery pipes connected to the water recovery ducts to collect the heated cooling water or the heated water to the main water reservoir,~~

~~alternatively, further comprising: water passages formed along the edges where the mass concrete and the ground meet each other to collect the heated cooling water or the heated water thereto; and water recovery pipes connected to the water passages to collect the heated cooling water or the heated water to the main water reservoir, and~~

~~alternatively, further comprising: water recovery pipes adapted to connect a position where the heated water or the heated cooling water gathers to the main water reservoir; and water recovery pumps provided to collect the heated water or the heated cooling water to the main water reservoir through the water recovery pipes.~~

~~【Claim 4】~~

~~The apparatus as defined in claim 3, further comprising:~~

~~first pumps disposed between the main water reservoir and the pipes to supply the cooling water to the pipes; and~~

~~second pumps disposed between the auxiliary water reservoir and the supply pipes to supply the heated water to the supply pipes.~~

【Claim ~~5~~2】

The apparatus as defined in claim ~~4~~1, further comprising a curing blanket covered on the outer surface of the mass concrete to absorb a portion of the heated cooling water or the heated water being discharged through the holes, thereby allowing the absorbed heated cooling water or the absorbed heated water to be contacted with the outer surface of the mass concrete.

【Claim ~~6~~3】

The apparatus as defined in claim ~~5~~2, further comprising a heat-retaining member covered on the curing blanket to keep the heat of the heated cooling water or the heated water absorbed to the curing blanket.

【Claim ~~7~~4】

The apparatus as defined in claim ~~6~~3, wherein the heat-retaining member is formed of vinyl canvas or bubble sheets.

【Claim ~~8~~5】

The apparatus as defined in claim ~~4~~1, wherein the auxiliary water reservoir comprises heating means adapted to heat the heated water stored thereinto.

【Claim ~~9~~6】

The apparatus as defined in claim ~~8~~5, further comprising a surface portion temperature sensor disposed on the outer surface of the mass concrete to measure the temperature of the outer surface and a center portion temperature sensor disposed in the interior of the mass concrete to measure the temperature of the interior of the mass concrete, wherein the control unit is connected to the heating means to supply power to the heating means and operates the switching valves if the temperature of the interior of the mass concrete obtained from the center portion temperature sensor is less than the set temperature, so that the supply of the heated cooling water from the pipes to the hoses stops and the heated water from the supply pipes to the hoses is supplied.

【Claim ~~10~~7】

The apparatus as defined in claim ~~9~~6, further comprising a connection pipe provided between the auxiliary water reservoir and the main water reservoir to supply the cooling water stored in the main water reservoir to the auxiliary water reservoir.

【Claim ~~11~~8】

The apparatus as defined in claim ~~9~~6, wherein the control unit controls the first pumps to adjust the flow rate of the cooling water being supplied to the pipes and the second pumps to adjust the flow rate of the heated water being supplied to the hoses.

【Claim ~~12~~9】

The apparatus as defined in claim ~~11~~8, wherein the temperature difference from the interior to the outer surface of the mass concrete is calculated by the control unit, and if the temperature difference calculated by the control unit is more than the set temperature difference, the first pumps are operated to supply the cooling water to the pipes.

【Claim ~~13~~10】

A method for reducing a temperature difference generated in mass concrete, the method comprising the steps of:

assembling iron bars, setting up a form, and disposing at least one or more pipes inside the form in such a manner as to be passed through the mass concrete built by casting concrete in the form;

disposing at least one or more hoses, each having a plurality of holes formed on the outer periphery thereof, on the outer surface of the mass concrete, connecting the other side ends of the pipes to the hoses and one side ends of the pipes to a main water reservoir into which the cooling water is stored; and disposing an auxiliary water reservoir in which heated water is stored and supply pipes adapted to supply the heated water to the outer surface of the mass concrete;

disposing water recovery ducts on the sides of the mass concrete or forming water passages on the edges where the mass concrete and the ground meets each other;

supplying the cooling water stored in the main water reservoir to the pipes by means of first pumps, when the temperature difference from the interior to the outer surface of the mass concrete is generated;

cooling the interior of the mass concrete by the cooling water supplied to the pipes and supplying the heated cooling water to the hoses;

discharging the heated cooling water through the holes of the hoses to heat the outer surface of the mass concrete, collecting the heated cooling water to the water passages or the water recovery ducts, returning the heated cooling water to the main water reservoir through water recovery pipes connected to the water passages or the water recovery ducts and water recovery pumps mounted on the water recovery pipes; and

if the temperature of the interior of the mass concrete is less than a set temperature, stopping the operations of the first pumps by a control unit to shut off the supply of the

cooling water supplied to the pipes, operating second pumps disposed between the supply pipes and the auxiliary water reservoir by the control unit to supply the heated water to the outer surface of the mass concrete through the supply pipes,

wherein the step of disposing the supply pipes further comprises the step of disposing switching valves between the pipes and the hoses in such a manner as to be connected to the supply pipes, and the step of supplying the heated water to the outer surface of the mass concrete further comprises the steps of operating the switching valves by the control unit to shut off the supply of the cooling water supplied to the pipes and supplying the heated water to the hoses through the supply pipes if the temperature of the interior of the mass concrete is less than the set temperature,

further comprising the step of supplying power to heating means mounted inside the auxiliary water reservoir by the control of the control to heat the heated water,

wherein the flow rate of the cooling water being supplied to the pipes and the flow rate of the heated water being supplied to the supply pipes are adjusted by the control unit, and

wherein the temperature difference from the interior to the outer surface of the mass concrete is calculated by the control unit, based upon the temperatures of the outer surface and the interior of the mass concrete obtained from a surface portion temperature sensor disposed on the outer surface of the mass concrete and a center portion temperature sensor disposed in the interior of the mass concrete, so that if the temperature difference calculated by the control unit is more than the set temperature difference, the first pumps are operated.

~~【Claim 14】~~

~~The method as defined in claim 13, wherein the step of disposing the supply pipes further comprises the step of disposing switching valves between the pipes and the hoses in such a manner as to be connected to the supply pipes, and the step of supplying the heated water to the outer surface of the mass concrete further comprises the steps of operating the switching valves by the control unit to shut off the supply of the cooling water supplied to the pipes and supplying the heated water to the hoses through the supply pipes if the temperature of the interior of the mass concrete is less than the set temperature.~~

【Claim ~~15~~11】

The method as defined in claim ~~13~~10, wherein the step of disposing the supply pipes further comprises the step of disposing a curing blanket on the outer surface of the mass concrete, so that the curing blanket absorbs a portion of the heated water discharged through the plurality of holes of the hoses thereto, in the step of collecting the heated cooling water.

【Claim ~~16~~12】

The method as defined in claim ~~15~~11, wherein after the step of disposing the curing blanket, a heat-retaining member is covered on the curing blanket.

~~【Claim 17】~~

~~The method as defined in claim 13, further comprising the step of supplying power to heating means mounted inside the auxiliary water reservoir by the control of the control to heat the heated water.~~

~~【Claim 18】~~

~~The method as defined in claim 17, wherein the flow rate of the cooling water being supplied to the pipes and the flow rate of the heated water being supplied to the supply pipes are adjusted by the control unit.~~

~~【Claim 19】~~

~~The method as defined in claim 18, wherein the temperature difference from the interior to the outer surface of the mass concrete is calculated by the control unit, based upon the temperatures of the outer surface and the interior of the mass concrete obtained from a surface portion temperature sensor disposed on the outer surface of the mass concrete and a center portion temperature sensor disposed in the interior of the mass concrete, so that if the temperature difference calculated by the control unit is more than the set temperature difference, the first pumps are operated.~~

【Claim ~~20~~13】

The method as defined in claim ~~13~~10, wherein before the step of supplying the heated water to the outer surface of the mass concrete, a connection pipe is disposed between the main water reservoir and the auxiliary water reservoir to supply the cooling water stored in the main water reservoir to the auxiliary water reservoir.

【Claim ~~21~~14】

The method as defined in claim ~~20~~13, wherein after the curing process of the mass concrete is completed, the pipes are filled by means of grouting.

【Claim ~~22~~15】

The mass concrete cured by the method as defined in claim ~~13~~10.

Claims

【Claim 1】

An apparatus for reducing a temperature difference generated in mass concrete made by assembling iron bars, setting up a form and pouring concrete into the form, during a curing process of the mass concrete, the apparatus comprising:

a main water reservoir adapted to store cooling water thereinto;

pipes disposed inside the form in such a manner as to be buried in the interior of the mass concrete at the time of concrete casting, the pipes being spaced apart from each other by a given distance in such a manner as to be passed through the mass concrete and being connected to the main water reservoir from which the cooling water is supplied thereto, so that the temperature of the interior of the mass concrete is decreased and the cooling water supplied thereto is heated to discharge heated cooling water therefrom;

hoses disposed on the outer surface of the mass concrete in such a manner as to be connected to the output ends of the pipes from which the heated cooling water is supplied thereto, each hose having a plurality of holes formed on the outer periphery thereof, through which the heated cooling water is discharged;

an auxiliary water reservoir adapted to store heated water thereinto;

supply pipes connected to the auxiliary water reservoir to supply the heated water to the outer surface of the mass concrete if the temperature of the interior of the mass concrete is less than a set temperature; and

a control unit operated to supply the cooling water from the main water reservoir to the pipes if the temperature of the interior of the mass concrete is more than a set temperature and to supply the heated water from the auxiliary water reservoir to the supply pipes if the temperature of the interior of the mass concrete is less than the set temperature,

the apparatus further comprising:

switching valves mounted at positions where the output ends of the supply pipes are disposed between the pipes and the hoses to shut off the supply of the cooling water, while

supplying the heated water to the hoses through the supply pipes, if the temperature of the interior of the mass concrete is less than the set temperature,

water recovery ducts disposed along the edges of the mass concrete so as to collect the heated cooling water or the heated water flowing along the outer surface of the mass concrete through the discharging from the plurality of holes of the hoses disposed on the outer surface of the mass concrete; and water recovery pipes connected to the water recovery ducts to collect the heated cooling water or the heated water to the main water reservoir,

water passages formed along the edges where the mass concrete and the ground meet each other to collect the heated cooling water or the heated water thereto; and water recovery pipes connected to the water passages to collect the heated cooling water or the heated water to the main water reservoir, and

water recovery pipes adapted to connect a position where the heated water or the heated cooling water gathers to the main water reservoir; and water recovery pumps provided to collect the heated water or the heated cooling water to the main water reservoir through the water recovery pipes,

first pumps disposed between the main water reservoir and the pipes to supply the cooling water to the pipes; and

second pumps disposed between the auxiliary water reservoir and the supply pipes to supply the heated water to the supply pipes.

【Claim 2】

The apparatus as defined in claim 1, further comprising a curing blanket covered on the outer surface of the mass concrete to absorb a portion of the heated cooling water or the heated water being discharged through the holes, thereby allowing the absorbed heated cooling water or the absorbed heated water to be contacted with the outer surface of the mass concrete.

【Claim 3】

The apparatus as defined in claim 2, further comprising a heat-retaining member covered on the curing blanket to keep the heat of the heated cooling water or the heated water absorbed to the curing blanket.

【Claim 4】

The apparatus as defined in claim 3, wherein the heat-retaining member is formed of vinyl canvas or bubble sheets.

【Claim 5】

The apparatus as defined in claim 1, wherein the auxiliary water reservoir comprises heating means adapted to heat the heated water stored thereinto.

【Claim 6】

The apparatus as defined in claim 5, further comprising a surface portion temperature sensor disposed on the outer surface of the mass concrete to measure the temperature of the outer surface and a center portion temperature sensor disposed in the interior of the mass concrete to measure the temperature of the interior of the mass concrete, wherein the control unit is connected to the heating means to supply power to the heating means and operates the switching valves if the temperature of the interior of the mass concrete obtained from the center portion temperature sensor is less than the set temperature, so that the supply of the heated cooling water from the pipes to the hoses stops and the heated water from the supply pipes to the hoses is supplied.

【Claim 7】

The apparatus as defined in claim 6, further comprising a connection pipe provided between the auxiliary water reservoir and the main water reservoir to supply the cooling water stored in the main water reservoir to the auxiliary water reservoir.

【Claim 8】

The apparatus as defined in claim 6, wherein the control unit controls the first pumps to adjust the flow rate of the cooling water being supplied to the pipes and the second pumps to adjust the flow rate of the heated water being supplied to the hoses.

【Claim 9】

The apparatus as defined in claim 8, wherein the temperature difference from the interior to the outer surface of the mass concrete is calculated by the control unit, and if the temperature difference calculated by the control unit is more than the set temperature difference, the first pumps are operated to supply the cooling water to the pipes.

【Claim 10】

A method for reducing a temperature difference generated in mass concrete, the method comprising the steps of:

assembling iron bars, setting up a form, and disposing at least one or more pipes inside the form in such a manner as to be passed through the mass concrete built by casting concrete in the form;

disposing at least one or more hoses, each having a plurality of holes formed on the outer periphery thereof, on the outer surface of the mass concrete, connecting the other side ends of the pipes to the hoses and one side ends of the pipes to a main water reservoir into which the cooling water is stored; and disposing an auxiliary water reservoir in which heated water is stored and supply pipes adapted to supply the heated water to the outer surface of the mass concrete;

disposing water recovery ducts on the sides of the mass concrete or forming water passages on the edges where the mass concrete and the ground meets each other;

supplying the cooling water stored in the main water reservoir to the pipes by means of first pumps, when the temperature difference from the interior to the outer surface of the mass concrete is generated;

cooling the interior of the mass concrete by the cooling water supplied to the pipes and supplying the heated cooling water to the hoses;

discharging the heated cooling water through the holes of the hoses to heat the outer surface of the mass concrete, collecting the heated cooling water to the water passages or the water recovery ducts, returning the heated cooling water to the main water reservoir through water recovery pipes connected to the water passages or the water recovery ducts and water recovery pumps mounted on the water recovery pipes; and

if the temperature of the interior of the mass concrete is less than a set temperature, stopping the operations of the first pumps by a control unit to shut off the supply of the cooling water supplied to the pipes, operating second pumps disposed between the supply pipes and the auxiliary water reservoir by the control unit to supply the heated water to the outer surface of the mass concrete through the supply pipes,

wherein the step of disposing the supply pipes further comprises the step of disposing switching valves between the pipes and the hoses in such a manner as to be connected to the supply pipes, and the step of supplying the heated water to the outer surface of the mass concrete further comprises the steps of operating the switching valves by the control unit to shut off the supply of the cooling water supplied to the pipes and supplying the heated water to the hoses through the supply pipes if the temperature of the interior of the mass concrete is less than the set temperature,

further comprising the step of supplying power to heating means mounted inside the auxiliary water reservoir by the control of the control to heat the heated water,

wherein the flow rate of the cooling water being supplied to the pipes and the flow rate of the heated water being supplied to the supply pipes are adjusted by the control unit, and

wherein the temperature difference from the interior to the outer surface of the mass concrete is calculated by the control unit, based upon the temperatures of the outer surface and the interior of the mass concrete obtained from a surface portion temperature sensor disposed on the outer surface of the mass concrete and a center portion temperature sensor disposed in the interior of the mass concrete, so that if the temperature difference calculated by the control unit is more than the set temperature difference, the first pumps are operated.

【Claim 11】

The method as defined in claim 10, wherein the step of disposing the supply pipes further comprises the step of disposing a curing blanket on the outer surface of the mass concrete, so that the curing blanket absorbs a portion of the heated water discharged through the plurality of holes of the hoses thereto, in the step of collecting the heated cooling water.

【Claim 12】

The method as defined in claim 11, wherein after the step of disposing the curing blanket, a heat-retaining member is covered on the curing blanket.

【Claim 13】

The method as defined in claim 10, wherein before the step of supplying the heated water to the outer surface of the mass concrete, a connection pipe is disposed between the main water reservoir and the auxiliary water reservoir to supply the cooling water stored in the main water reservoir to the auxiliary water reservoir.

【Claim 14】

The method as defined in claim 13, wherein after the curing process of the mass concrete is completed, the pipes are filled by means of grouting.

【Claim 15】

The mass concrete cured by the method as defined in claim 10.